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SEPARATION BARRIER WALL INSTALLATION CONSTRUCTION COMPLETION REPORT

AMERICAN CHEMICAL SERVICE INC.
NPL SITE
GRIFFITH, INDIANA

Approved
3/29/02
KA.

MWH File No. 2090601

Prepared For:

American Chemical Service NPL Site RD/RA Executive Committee
Griffith, Indiana

Prepared By:

MWH
27755 Diehl Road, Suite 300
Warrenville, Illinois 60555

March 2002

MWH
MONTGOMERY WATSON HARZA

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Prepared For:

American Chemical Service NPL Site RD/RA Executive Committee
Griffith, Indiana

Prepared by: _____ 3/19/02
Robert A. Adams, P.E. Date
Senior Engineer

Approved by: _____ 3/19/02
FOR Peter Vagt, Ph.D., CPG Date
Project Manager

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1.0 INTRODUCTION

This construction completion report summarizes the installation of the separation barrier wall between the On-Site Area and Off-Site Area of the American Chemical Service, Inc. (ACS) NPL Site in Griffith, Indiana during January and February 2001.

1.1 SITE BACKGROUND

The ACS NPL Site is an operating chemical processing facility. Past operations have impacted five land disposal areas: the On-Site Containment Area (ONCA), the Still Bottom Ponds Area, the Treatment Lagoons, the Off-Site Containment Area (OFCA), and the Kapica/Pazmey Area (K-P Area). The OFCA and K-P Area are collectively known as the Off-Site Area. A portion of the wetlands located to the west of the ACS Site has also been impacted.

In 1997, a continuous perimeter barrier wall was installed around the ONCA, the ACS operating facility (including the Still Bottoms Pond Area and Treatment Lagoons), the OFCA and the K-P Area. The barrier wall encloses the known contamination source areas at the Site. It is keyed at least 2 to 4 feet into the confining clay layer. The clay layer is located at a depth that ranges from approximately 20 to 23 feet below ground surface. This separation barrier wall was constructed to divide the ACS Site within the perimeter barrier wall into two sections.

1.2 PURPOSE OF SEPARATION BARRIER WALL

The objective of the separation barrier wall is to provide a continuous, vertical, hydraulic cutoff wall to isolate groundwater on the northern side of the site (the On-Site Area) and prevent migration of contaminated groundwater to the southern side of the site (the Off-Site Area) when dewatering efforts are increased there. Hydraulic isolation of the On-Site Area and Off-Site Area will aid in dewatering each side of the site to increase the efficiency of the In-Situ Vapor Extraction (ISVE) systems to be installed in each area. The interior barrier wall was designed to maintain a hydraulic conductivity similar to that of the original perimeter barrier wall, with a target hydraulic conductivity of approximately 1×10^{-7} centimeters per second (cm/s). Montgomery Watson Harza (MWH), formerly Montgomery Watson, selected Contract Dewatering Services, Inc. (CDS) to perform the installation of the separation barrier wall using a trenching technique. Hanson Engineering was subcontracted by CDS to prepare the final/implementation work plans and quality control plans, prepare on-site engineering support for CDS, and prepare construction documentation and certification.

Further detail regarding the objectives of the separation barrier wall and ISVE systems are contained in the Final Remedial Design Report (MWH, August 1999).

2.0 SUMMARY OF CONSTRUCTION ACTIVITIES

2.1 INTRODUCTION

Contract Dewatering Services, Inc. (CDS) began construction of the separation barrier wall on January 9, 2001 and demobilized from the site on February 5, 2001 after completing the work detailed in this document. A full report of the construction activities, installation procedures, and quality control procedures is included in the Construction Documentation Report written by Hanson Engineering, a subcontractor for CDS (see Appendix A). Daily air monitoring logs submitted to MWH by Hanson Engineering are included in Appendix B. MWH personnel were on site throughout the construction activities and conducted regular quality assurance air monitoring of the perimeter of the exclusion zone. These air monitoring results are highlighted in the daily summaries included in Section 2.2 of this report. Figure 1 shows the final installed alignment of the separation barrier wall. Photographs of the construction process are included as Appendix C.

The initial MWH design called for the separation barrier wall to be connected to the original high density polyethylene (HDPE) perimeter barrier wall. However, during construction these connections were eliminated to minimize the potential for damaging and compromising the integrity of the original barrier wall. As a result of this modification the separation barrier wall stops approximately three feet short of the HDPE wall on each side. As a result, there is an approximately three-foot gap at each end of the 700 foot long barrier wall, which represents less than $1/10^{th}$ of a percent. Since the separation barrier wall is internal to the primary barrier wall, it was felt that the small amount of potential seepage through these end gaps was a reasonable trade-off for assurance that the primary wall remained intact.

2.2 A BRIEF CHRONOLOGY OF CONSTRUCTION ACTIVITIES

This section describes the construction activities performed and equipment used for the installation of the separation barrier wall at the ACS site.

Week of November 23, 2000

CDS performed a series of test borings along the proposed separation barrier wall alignment, located approximately 25 feet south of the southernmost track of the existing railroad track which bi-sects the ACS site. The borings were taken to verify the depth to the surface of the underlying silty clay stratum and to obtain a composite sample of the sand overlying the clay for testing purposes. A sample of the groundwater was also obtained during this exploration activity. The information gathered from the test borings conducted by CDS is summarized in Appendix D of this report. NTH Consultants, Ltd. analyzed the clay and sand from the soil borings. These NTH analytical results were summarized in the "Report on Final Slurry Wall Design: Separation Barrier Wall" (Hanson Engineering, January 2001). Simalabs International analyzed the groundwater sampled during the exploration process. The Simalabs results were included in Appendix C of the

"Report on Final Slurry Wall Design: Separation Barrier Wall" (Hanson Engineering, January 2001).

January 9, 2001
CDS had already been on site since December 20, 2000 beginning another project on the site. CDS began work on the separation barrier wall on January 9, 2001, by digging an initial trench for the separation barrier wall, approximately three to four feet wide and two to three feet deep. The purpose of this initial trench was to create a mixing zone for combining the bentonite, groundwater, and in-situ soil which will make up the separation barrier wall. Bentonite powder was placed into this initial trench to a depth of approximately one-foot and mixed with in-situ soil and groundwater by the trenching process. Additional water was later added as needed during the trenching process. MWH and Hanson conducted air monitoring during the trenching activities. All photo-ionization detector (PID) air monitoring readings collected were 0.0 parts per million (ppm).

January 10, 2001
CDS continued digging the initial trench. Bags of bentonite began to be delivered to the Site. A copy of the bentonite manufacturer's specification sheets are included in Appendix E of this report.

January 11, 2001
CDS completed preparation of the initial trench sufficiently to begin installation of the separation barrier wall by placing bentonite into the trench already dug. In addition, ground surface elevations were obtained at 100 foot intervals along the alignment of the separation barrier wall. More bentonite bags were delivered to the Site. No digging or other intrusive work was conducted. The remaining sections of the initial shallow surface trench were completed as the job progressed.

January 17, 2001
Hanson collected a sample of soil from the site along the separation barrier wall alignment, which they sent to NTH Consultants, Ltd. of Farmington Hills, Michigan to determine the acceptable slump range for the soil-bentonite slurry mix design. CDS physically confirmed the location of the perimeter barrier wall at either end along the proposed separation barrier wall alignment. CDS also located the Barrier Wall Extraction System HDPE air and water lines running in the vicinity of the proposed separation barrier wall alignment. The trencher was examined and was prepared for operation.

January 18, 2001
Hanson and CDS further delineated utility lines in vicinity of separation barrier wall alignment and prepared to begin work.

January 19, 2001
CDS started the trencher and inserted the boom into the ground to confirm that the trencher was operating properly. During this operational test, the upper sprocket of the trenching chain sheared into two pieces and required repair.

January 23, 2001
CDS began trenching the separation barrier wall. CDS began to insert the boom of the trencher at approximately station 6+65 and moved eastward to the end of the trench as the boom was slowly lowered into position. Once in position, trenching work began at the east end of the trench, station 6+82 (see Figure 1), three feet west of the previously installed HDPE barrier wall, and moved westward. Station 0+00 was established at the far west end of the separation barrier wall. The trencher reached station 5+65 by the end of the day, trenching a total of 117 feet. Both MWH and Hanson conducted air monitoring regularly throughout the day. The highest PID reading was 0.8 ppm. Hanson recorded the elevation of the trench bottom every ten feet throughout the trenching process. Slurry Confirmation Samples 1A and 1B were collected from station 6+67 of the separation barrier wall at a depth of 12-15 feet. The slurry confirmation sample results are summarized in Appendix F. The sample was analyzed in the field for unit weight and slump. MWH and Hanson split each slurry confirmation sample, dividing the sample into two separate containers for laboratory analysis. NTH Consultants, Ltd. of Farmington Hills, Michigan laboratory analyzed each field sample submitted by Hanson for unit weight, grain size, and hydraulic conductivity as part of the Quality Control/Quality Analysis plan. Great Lakes Soil and Environmental Consultants, Inc. of Burr Ridge, Illinois laboratory analyzed each field sample submitted by MWH for grain size and hydraulic conductivity as part of the Quality Control/Quality Analysis plan.

January 24, 2001
The trenching continued from station 5+65 to 5+25. The trencher encountered increased resistance between stations 5+35 and 5+50, possibly indicating the presence of buried debris. The trencher was able to continue trenching, indicating that no sizeable debris had been encountered. However the air monitoring readings, which had remained below 1 ppm up to that point, rose to 5-6 ppm, and briefly peaked above 50 ppm. At that point, work stopped and crewmembers moved upwind. Because air monitoring levels had risen above 1 ppm, an interim exclusion zone was established by crewmembers wearing Level C PPE. MWH personnel used Draeger tubes to test for benzene while wearing appropriate cartridge-type respirators. A non-detect reading was recorded. Although the Draeger tube indicated no benzene, the elevated PID readings justified suspending work and establishing an interim exclusion zone.

January 25, 2001
A permanent exclusion zone was established, and CDS, Hanson, and MWH prepared to begin work again in Level C Personal Protective Equipment (PPE). Air monitoring was performed, but no readings were recorded above 1 ppm. The trench alignment and offset from nearby train tracks was recorded. No trenching occurred on January 25, 2001. The excavator began to push the overburden back into the trench from the first 100 feet of trenching and re-cover with clay. Slurry Confirmation Samples 2A and 2B were collected on January 25, 2001 from station 5+95 at a depth of 12-15 feet.

January 29, 2001
Trenching resumed on January 29, 2001 with the workers in the exclusion zone wearing Level C PPE. Trenching progressed from station 5+25 to station 3+85, for a total of

140 feet. Hanson and MWH continued air monitoring both inside of the exclusion zone and around the perimeter. Air monitoring inside the exclusion zone remained in the 10-20 ppm range during the morning, with peaks ranging from 90-200 ppm. In the afternoon, readings decreased to the 2-3 ppm range after the trencher left the region of increased PID readings first encountered on January 25, 2001.

Hanson pulled Draeger tubes for vinyl chloride, methylene chloride, phenol, and benzene. Readings for all four compounds were 0 ppm, though there were the slight beginnings of a color change in the benzene and methylene chloride tubes. Perimeter air monitoring remained in the 0 to 1.0 ppm range. During a brief period of perimeter readings above 1 ppm in the afternoon due to shifting wind, respirators were worn outside in addition to inside the exclusion zone. Engineering and health and safety controls were taken instead of expanding the exclusion zone due to the transient nature of the wind. No slurry confirmation samples were collected.

January 30, 2001

Work progressed from station 3+85 to 3+45. The trencher boom broke an end-bearing in the late morning, and CDS spent the remainder of the day repairing the trencher. Air monitoring was conducted as usual in the exclusion zone and at the perimeters. In the morning, air monitoring levels outside the exclusion zone were elevated above 1 ppm for two hours. During that time, respirators were worn both outside and inside the exclusion zone. Hanson pulled Draeger tubes for vinyl chloride, methylene chloride, phenol, and benzene. No detections were observed for these compounds. No slurry confirmation sampling was conducted on this date .

January 31, 2001

Three hundred and twenty feet were trenched on January 31, 2001. Trenching continued from approximately station 3+45 to 0+25. As the trencher worked, the excavator pushed the overburden back into the trench behind the trencher. Air monitoring was conducted as usual in the exclusion zone and at the perimeters. Exclusion zone levels remained below 3 to 4 ppm. Hanson pulled three sets of Draeger tubes during the day for vinyl chloride, methylene chloride, phenol, and benzene. No detections were observed for these compounds. Perimeter air levels rose above 1 ppm for two brief periods, once in the morning and once in the afternoon, during which respirators were also worn outside the exclusion zone. MWH installed approximately 20 feet of black geofabric across the trench, about 100 feet from the east end, to facilitate vehicular traffic crossing the completed trench. Slurry Confirmation Samples 3, 4, and 5 were collected from stations 4+85, 4+45, and 3+70 respectively at depths of 12-15 feet.

February 1, 2001

The remaining 25 feet of trenching were completed on February 1, 2001. Trenching stopped three feet east of the previously installed HDPE barrier wall. Completion was witnessed by Black & Veatch, MWH, CDS, and Hanson. The trencher chain broke as work began in the morning, but CDS repaired the chain and began trenching again in the late afternoon. Air monitoring was conducted as usual. Perimeter air monitoring levels remained below 1 ppm, except for a brief peak of 1.8 ppm in late afternoon. Respirators

were used outside the exclusion zone when monitoring levels exceeded 1 ppm. No slurry confirmation samples were taken. Hanson used a transit to measure the ground surface elevations along the trench alignment for use in the preparation of their final report.

February 2, 2001
Hanson and MWH collected the final four samples, Slurry Confirmation Samples 6, 7, 8 and 9 at depths of 12-15 feet. These were collected at stations 2+55, 1+80, 1+05, and 0+30 respectively. The excavator finished pushing in the remaining overburden back into the trench.

February 5, 2001
CDS began decontaminating their equipment and preparing to demobilize equipment from the site. The exclusion zone was removed.

February 6, 2001
CDS finished decontaminating their equipment, and the trencher was demobilized from the site.

3.0 MATERIAL TESTING AND QUALITY CONFIRMATION

Material testing and quality confirmation measures were taken in accordance with the Construction Quality Assurance Plan (CQAP) (Montgomery Watson, June 1999) to assure that the completed separation barrier wall met the applicable performance requirements. Prior to installation, CDS drilled test borings along the proposed alignment of the wall to confirm the depth of the clay layer. The pertinent data from the test borings is included in Appendix D. Laboratory testing was conducted by NTH Consultants, Ltd. (NTH) on the bentonite slurry prior to installation to determine the ideal mix ratio. The results of the testing are included in Appendix G. On-site slurry density and slump testing was conducted by Hanson Engineering and the results are summarized in Appendix F.

During construction, samples were collected from the installed slurry and submitted for laboratory testing by NTH to confirm that the permeability of the slurry would meet the required performance specifications, including the target permeability (or hydraulic conductivity) of approximately 1×10^{-7} cm/s or less. These field samples were split and the and the second part of each sample was sent to Great Lakes Soil and Environmental Consultants, Inc. by MWH to test for satisfactory grain size distribution and permeability. There was some variance between the permeability results reported by Great Lakes and NTH. The variability is probably related to the fact that they used different test methods of determining permeability. Great Lakes used a flexible wall permeability test method (ASTM D5084), while NTH used a falling head permeability test method (EPA Method 9100, Section 2.6). Results from the two methods often vary. The flexible wall method is generally acknowledged to yield higher permeability results. To negate potential biases from each method, the NTH results and Great Lakes results were averaged together, resulting in a permeability of 9.8×10^{-8} cm/s, a value that meets the design target.

The sole purpose of the separation barrier wall is to divide the area within the perimeter barrier wall into two regions in order to allow the On-Site and Off-Site Areas to be dewatered independently. To accomplish this objective, a design permeability criteria of 1×10^{-7} centimeters per second (cm/s) was established by MWH as a target permeability for our subcontractor, but not as a design criteria that was a critical factor in the performance of the wall. Even if the Great Lakes average permeability of 1.6×10^{-7} cm/s is assumed, calculations indicate that the separation barrier wall will allow a maximum of 7,000 more gallons of water to pass through it annually than if the target permeability of 1.0×10^{-7} cm/s is assumed. Assuming a nominal extraction rate of 30 gallons per minute from the Off-Site Area, the additional 7,000 gallons of water per year allowed to pass through the wall would result in approximately four more hours of pumping time. Based upon this, the separation barrier wall, as constructed, will effectively fulfill its purpose of allowing the On-Site and Off-Site Areas to be dewatered independently as stated in the Final Remedy.

A copy of Great Lakes' test report is included in Appendix G and Table 1 summarizes the results of the permeability testing conducted by NTH and Great Lakes. Note that the station numbering system used to identify sample locations by Great Lakes varied from the system used by NTH. Great Lakes used numbers, which began at the east end of the wall

instead of the west end. Table 1 helps to clarify this variance. A sketch of the sampling device used to collect slurry for analysis is included in Appendix B.

Hanson Engineering regularly confirmed the depth of the separation barrier wall during construction by recording the elevation of a known reference point on the boom of the trencher. Hanson then calculated the corresponding elevation of the trench bottom using the known fixed length of the trencher boom. This confirmation procedure was done every 10 feet along the trench. A figure and table detailing the depth of the separation barrier wall is included in Appendix B. At three locations along the trench alignment, Hanson confirmed the depth of the separation barrier wall by physically inserting a rod to the bottom of the trench and recording the depth.

Appendix E contains the manufacturers product specification sheets for the Bentonite powder used in the construction of the wall.

4.0 HEALTH AND SAFETY

Regular air monitoring was conducted throughout the construction of the separation barrier wall. Daily air monitoring logs prepared by Hanson Engineering are included in Appendix B. Appropriate exclusion zones were established and personal protective equipment (PPE) was worn as required. Pictures of the PPE worn, the exclusion zones, and the air monitoring conducted are included in Appendix C.

5.0 SUMMARY

The separation barrier wall was designed to divide the area within the original HDPE perimeter barrier wall into two portions, each of which could be independently dewatered in preparation for the operation of the ISVE system. The separation barrier wall, constructed of a mixture of bentonite, in-situ soil, and water, was installed using a trenching technique. The wall provides a continuous, vertical, hydraulic cutoff wall to inhibit groundwater flow between the On-Site and Off-Site Areas by keying into the confining clay layer below the surface.

The initial MWH design called for the separation barrier wall to be connected to the original HDPE perimeter barrier wall. However, during construction these connections were eliminated to minimize the potential for damaging and compromising the integrity of the original barrier wall. As a result of this modification the separation barrier wall stops approximately three feet short of the HDPE wall on each side. As a result, there is an approximately three-foot gap at each end of the 700 foot long barrier wall, which represents less than $1/10^{th}$ of a percent. Since the separation barrier wall is internal to the primary barrier wall, it was felt that the small amount of potential seepage through these end gaps was a reasonable trade-off for assurance that the primary wall remained intact.

Quality control and assurance measures performed during and after construction confirm that the separation barrier wall, as constructed, will accomplish its objective.

TMK/RAA/PJV/jmf/JDP/TMK/jmf/TMK/RAA/jmf
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2090601

Table 1
Summary of Permeability Testing
Separation Barrier Wall
American Chemical Service, Inc.
NPL Site
Griffith, Indiana

Slurry Confirmation Sample	Date collected	Stationing used by Great Lakes (starting from east end of SBW)	Stationing used by Hanson and NTH (starting from west end of SBW)	Permeability Results (in cm/s)	
				Great Lakes	NTH
1A	1/23/01	0+18	6+67	6.4×10^{-8}	3.3×10^{-8}
1B	1/23/01	0+18	6+67	1.2×10^{-7}	NA
2A	1/25/01	0+90	5+95	7.4×10^{-8}	NA
2B	1/25/01	0+90	5+95	8.5×10^{-8}	NA
3	1/31/01	2+00	4+85	1.4×10^{-7}	3.4×10^{-8}
4	1/31/01	2+40	4+45	3.2×10^{-7}	NA
5	1/31/01	3+15	3+70	6.0×10^{-7}	4.0×10^{-8}
6[1]	2/2/01	4+30	2+55	4.6×10^{-8}	NA
7	2/2/01	5+05	1+80	3.8×10^{-8}	3.4×10^{-8}
8	2/2/01	5+80	1+05	5.6×10^{-8}	NA
9	2/2/01	6+55	0+30	1.8×10^{-7}	3.7×10^{-8}

Average Permeability	1.6×10^{-7}	3.6×10^{-8}
Combined Average Permeability	9.8×10^{-8}	
Design Target Permeability	1.0×10^{-7}	

Note:

NA = Not Analyzed

1. The station ID listed by Hanson for this location is not consistent with the station ID used by MWH for the same location. As in all other samples, the NTH sample and Great Lakes sample were collected from the same split sample. The MWH sample ID will be used.

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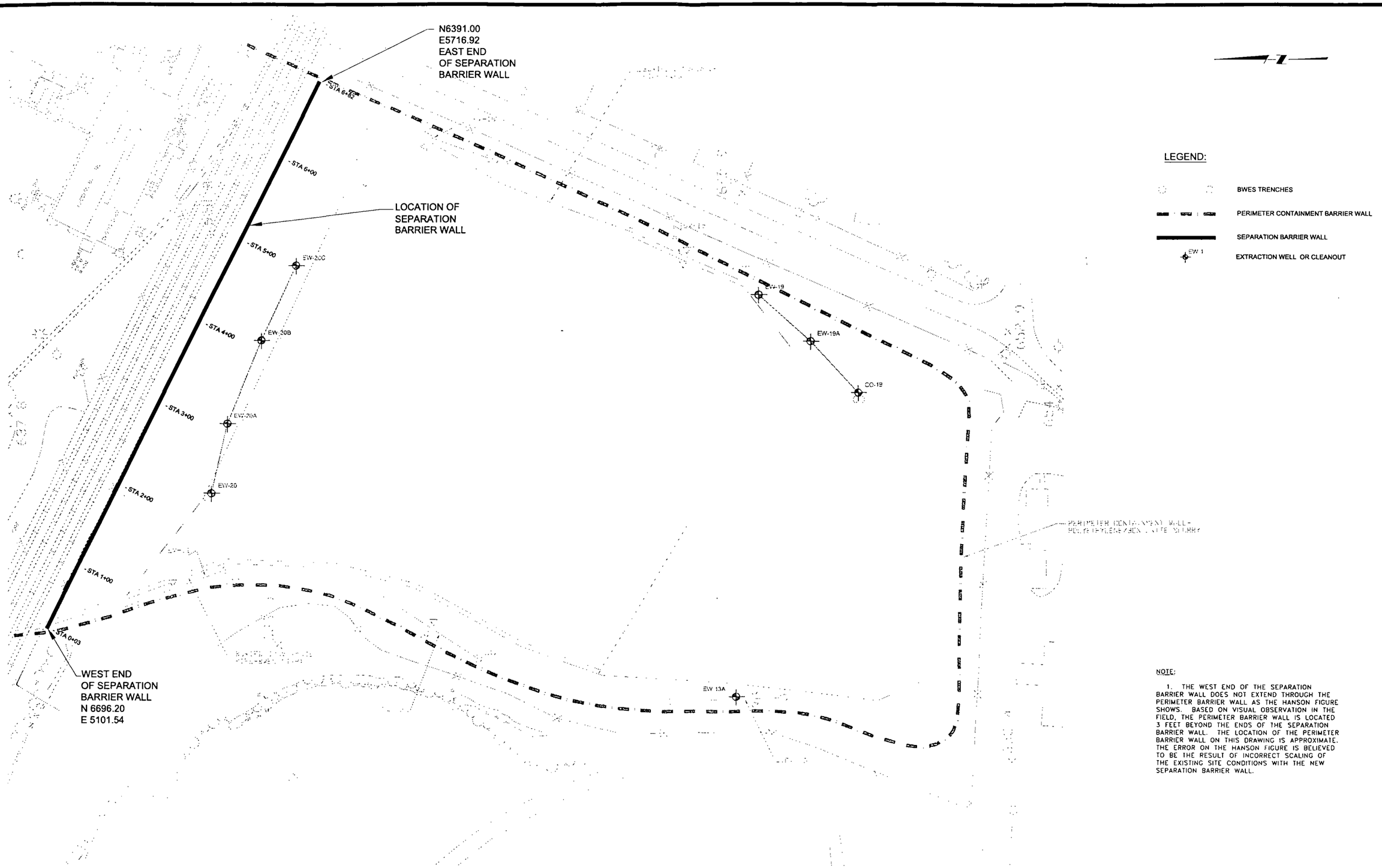


NOTE:

1. THE WEST END OF THE SEPARATION BARRIER WALL DOES NOT EXTEND THROUGH THE PERIMETER BARRIER WALL AS THE HANSON FIGURE SHOWS. BASED ON VISUAL OBSERVATION IN THE FIELD, THE PERIMETER BARRIER WALL IS LOCATED 3 FEET BEYOND THE ENDS OF THE SEPARATION BARRIER WALL. THE LOCATION OF THE PERIMETER BARRIER WALL ON THIS DRAWING IS APPROXIMATE. THE ERROR ON THE HANSON FIGURE IS BELIEVED TO BE THE RESULT OF INCORRECT SCALING OF THE EXISTING SITE CONDITIONS WITH THE NEW SEPARATION BARRIER WALL.

REV	DATE	BY	DESCRIPTION

SCALE: 1" = 50'-0"

WARNING: 0 1/2 1 — IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

DESIGNED _____ DRAWN _____ CHECKED _____

SUBMITTED BY

(PROJECT MANAGER) _____ LICENSE NO. _____ DATE _____

(COMPANY OFFICER) _____ LICENSE NO. _____ DATE _____

MWH
MONTGOMERY WATSON HARZA

ACS RD/RA GROUP
AMERICAN CHEMICAL SERVICE SUPERFUND SITE
GRIFFITH, INDIANA

OFF-SITE AREA
SEPARATION BARRIER WALL ALIGNMENT
"AS BUILT"

FIGURE
1

Job No. MW Job # F:\0_J-209\0601 ACS\105\dgn\mg\MWH_SBW_AS_BUILT.DWG

APPENDIX A

Construction Documentation Report on Separation Barrier Wall Installation (Hanson Engineering)

HANSON
ENGINEERING P.C.
Soils, Foundation & Underground Specialists

March 5, 2001
Project No. 00192-011

Mr. Richard Neumann
Contract Dewatering, Inc.
5820 West Riverside Drive
P.O. Box 1
Saranac, Michigan 48881

Re: Construction Documentation Report
Separation Barrier Wall Installation
ACS RD/RA Group
American Chemical Service Superfund Site
Griffith, Indiana

Dear Mr. Neumann:

This document represents the Construction Documentation Report for the Separation Barrier Wall Project at the American Chemical Service (ACS) site in Griffith, Indiana. This report presents a summary of the construction activities related to the Separation Barrier Wall (SBW). Also presented herein is a summary of the laboratory and quality assurance testing performed during the wall construction together with "As Built" wall construction plans and details.

Project Overview

The ACS site is bisected by three sets of railroad tracks, which separate the operating plant site from the area previously used for chemical waste disposal. The plant area is located north of the railroads tracks and is termed the "On Site" area. The area south of the railroad tracks is identified as the "Off Site" area. A perimeter composite barrier wall was previously constructed around the entire ACS site. The composite barrier wall consisted of a mixed in place slurry wall constructed by the deep mix trencher methods with an HDPE liner inserted into the slurry wall. A series of collector wells have been installed within the containment wall system, which are currently discharging to an on-site treatment plant located north of the railroad tracks. The purpose of the SBW is to separate the ACS site into two distinct areas such that the ground water level on either side of the SBW can be lowered while reducing the amount of water, and contaminants, which would flow across the SBW.

SBW Requirements

The contract documents required that the SBW be located at least 25 feet south of the southernmost rail of the railroad tracks. The SBW had to exhibit a permeability of less than 1 x 10^{-7} cm/sec immediately following construction and for the design life of 10 years. The SBW was to extend two feet into the underlying clay deposit. The percentage of bentonite to be used in the soil-bentonite wall would be determined by laboratory testing. Samples of the in-situ wall were also to be obtained for quality assurance testing and the bottom of the wall trench probed to verify the embedment of the wall into the clay deposit. The wall was to be connected to the perimeter composite containment wall at both ends. Pump and treat operations of the contaminated ground water inside either the "On Site" or "Off Site" areas may occur, resulting in a gradient across the wall of as much as 30 feet.

SBW Mix Design and Test Results

The mix design for the SBW was performed prior to the construction of the SBW. The trial design mix was based on the previous mix that was utilized for the perimeter containment wall. The mixture for the perimeter wall system consisted of a soil-bentonite mixture with 4% bentonite by dry weight basis. The SBW pre-construction design was based on a dry unit weight of the final soil-bentonite mixture of 100 pounds per cubic foot (pcf) with the bentonite materials representing 4% of the dry weight of materials. The design slump of the mixture was to be in the range of 6 to 8 inches. Trial batches of this mixture were prepared by NTH Consultants, Ltd. at the direction of Hanson Engineering. The trial mixture was subjected to permeability testing using a fixed ring permeameter in accordance with EPA Method 9100, Section 2.6. Both tap water and a sample of the ground water from on site were used in the testing program. The results of the trial mix testing program are presented in the NTH report , which has been included in its entirety in Appendix A.

Review of the NTH test results indicates that a soil-bentonite mixture with 4% bentonite by dry weight basis develops a hydraulic conductivity in the range of 5.8 x 10^{-8} to 7.1 x 10^{-8} cm/sec when tap water is used as the permeant. When the permeant was changed to the on site ground water, the hydraulic conductivites increased slightly to the range of 7.2 x 10^{-8} to 9.9 x 10^{-8} cm/sec.

Separation Barrier Wall Layout

The project plans require that the SBW be located a minimum of 25 feet south of the southernmost rail of the railroad lines which bi-sect the site. The SBW design called for the SBW to extend from the perimeter barrier wall on the west to the perimeter barrier wall on the east along this alignment. Installation location for the SBW was determined by physically measuring a distance of 30 feet from the southernmost rail of the railroad tracks with a surveyors tape. A

stake was then placed at these offset distances at regular intervals along the alignment. At the time of wall layout, the on site GPS was not operational and so hand layout methods were utilized. The "As Built" location of the SBW has been determined by Area Survey Company under subcontract with Contract Dewatering, Inc. The end points for the SBW were determined to be N6696.20, E5101.54 at the west end and N6391.00, E5716.92 at the east end. A copy of the site plan for the project has been provided by Montgomery – Watson in AutoCad format. We have superimposed the "As Built" SBW location on this plan. The revised site plan with the "As Built" information for the SBW is attached in Appendix B.

SBW Construction Methods

The SBW was constructed by excavating a starter trench generally 4 feet wide at the top and 3 feet wide at the bottom of the trench with a depth ranging from 2 to 3. The contractor then placed Hydrogel 90™ bentonite powder into the starter trench at a rate of 233 lbs./ft. of trench. Based on the a maximum depth to top of clay of 23 feet, this application rate results in 5.06 pounds of bentonite per cubic foot of SBW mix. Due to bulking of the soil, it was estimated that the dry unit weight of the soil-bentonite mixture would be approximately 100 pounds per cubic foot (pcf). Thus, the application rate corresponds to approximately 5% bentonite by dry weight of mixture.

The trenching machine was inserted into the trench pre-cut and lowered to the design elevation. The trencher cut and mixed a 2 foot wide trench to depths ranging from 18 to 25 feet. The trench was extended a minimum of 2 feet into the underlying clay layer. The depth of trench was pre-determined by the contractor based on supplemental soil borings performed at 100-foot intervals along the trench alignment prior to excavating the pre-trench. No formal soil boring logs were kept from these supplemental borings because they were only made to determine the depth of the clay along the alignment. However, a one page log was created with depth to clay layer at each boring location. A copy of the pre-excavation supplemental soil boring logs and interpreted soil profile have been included herewith in Appendix C.

The clay layer was generally located between 20 and 22 feet below the existing ground surface. However, the clay layer was determined to be 16 feet below the existing ground surface at Stations 6+80 and 6+75. The top of clay layer at Stations 6+75 and 6+80 were obtained by touching the top of the clay layer with the trencher chain perpendicular to the ground surface and determining the clay layer elevation with a surveyor's level and a known point on the trencher boom arm. The bottom of trench elevations from Stations 6+80 to 4+80 were obtained by surveyor's level and a known point on the trencher boom arm, while the boom arm was perpendicular to the ground surface. The bottom of trench depth between Stations 0+03 and 4+80 were generally determined based on the amount of trencher boom arm measured above the ground surface with a tape measurer. This was due to the continuous air monitoring performed by Hanson Engineering personnel and ingress and egress constraints imposed by performing

work in Level C personnel protective equipment. A summary of the trench depth measurement has been prepared and is presented herewith as Appendix C.

To ensure the slurry wall did not extend through the clay layer, Montgomery Watson required the contractor to probe the trench bottom in 3 locations to verify that the SBW trench was underlain by clay soils. The probe depths were then compared with trench depths obtained during trenching. The trench bottom was probed by jetting a 30-foot long probe to the bottom of the slurry wall and determining the bottom elevation of the trench with a surveyor's level. These trench bottom elevations were found to be within acceptable tolerance when compared to the trench bottom elevations obtained while trenching. The underlying clay layer was confirmed by the fact that the probe encountered a solid formation below the separation barrier wall. A copy of the Observation of Trench Depth Table and a SBW Clay Key drawing are attached in Appendix C.

Sample Collection and QA Testing Program for SBW

Samples of the in-situ soil-bentonite slurry were generally obtained at or near the mid-depth of the SBW trench. Samples were collected by inserting a 4 inch diameter steel pipe sampler with a movable center plug to the desired depth within the slurry wall, opening the center plug, pushing the sampler another 3 feet, closing the center plug and withdrawing the enclosed cylinder of soil-bentonite mixture. Slump tests and wet unit weight determinations were made on each sample and a portion of the sample was then sealed in a double plastic bag and shipped to NTH Consultants laboratories for determination of moisture content and hydraulic conductivity testing. Samples were obtained at approximately 75-foot intervals along the trench alignment. Each sample was tested for slump, moisture content, and wet and dry unit weights. The samples from 150-foot intervals were also tested for hydraulic conductivity in a method similar to the pre-construction testing program for the trial mix. The first two samples were obtained at Station 6+67 at depth of 0 to 2 feet and 12 to 15 feet. The sample from 0 to 2 feet was obtained to compare the test results with the mid depth sample at the same location. It should be noted that sample locations were adjusted to minimize exposure to the high concentration of contaminants encountered while trenching between Stations 4+85 and 5+70. A sketch of the sampling device is attached in Appendix D.

The slump tests were performed in general conformance with Standard Test Method for Slump of Hydraulic-Cement Concrete, ASTM Designation C143. The wet unit weight was determined by placing the soil-bentonite sample into a unit weight bucket with a volume of 1/4 cubic foot and then weighing the bucket and enclosed soil-bentonite sample in accordance with ASTM C138. The results of the field testing program are summarized on the Record of Soil-Bentonite Mix Sample sheet in Appendix D. Review of the data in Appendix D indicates that the slump and wet unit weights ranged from 5½ to 9 inches and 120 to 131 pounds per cubic foot (pcf), respectively.

Laboratory test results indicate that the moisture content and permeability ranged from 22 to 35 percent and 3.3 x 10^{-8} to 4.0 x 10^{-8} cm/sec, respectively. Based on the field wet densities and the laboratory moisture contents, the dry density of the in place soil-bentonite mixture ranged from 88.9 pcf to 104.6 pcf with an average value of 96.5 pcf. A copy of the Record of Soil-Bentonite Mix Sample and NTH laboratory test results letter are attached in Appendix D.

Special Construction Details

There were two special construction details in the final design report: 1. The attachment of the separation barrier wall to the existing perimeter wall; 2. The subsurface utility crossings for the separation barrier wall. These details were revised during construction of the separation barrier wall.

The separation barrier wall and existing perimeter wall connection was detailed to consist of a series of trencher passes perpendicular to the SBW in order to fill the space between the end of the SBW and the perimeter barrier wall. During the initial trencher insertion, it became evident that the slurry in the perimeter wall system and the enclosed HDPE liner would not stand unsupported for any height. When attempting to trench a distance of 3 feet from and parallel to the existing perimeter wall, the contractor trenched down to a depth of approximately 5 feet below the ground surface and stopped to examine the progress and found that trenching operations had exposed the perimeter wall HDPE liner. It was noted during examination of the HDPE liner that the liner was not installed straight up and down, and tended to move laterally within the slurry wall. If further trenching had continued in this location, the integrity of the perimeter wall would be compromised and the HDPE liner would be damaged. After discussions between Montgomery Watson and the contractor it was agreed to trench within 3 feet of the perimeter wall with the trencher perpendicular to the existing perimeter wall. According to Montgomery Watson, the 3-foot opening at the ends of the SBW is preferable to damaging the HDPE liner and compromising the integrity of the perimeter wall. As a result, Contract Dewatering Inc. trenched to within 3 feet of the existing perimeter wall at the east and west ends of the SBW.

The subsurface utility penetration through the SBW was revised from the final design report recommendation, which stated, "After the trencher has passed, road plates should be driven perpendicular to the soil-bentonite filled trench on either side of the utility crossing. The soil area between the two plates may then be excavated, bracing the plates as necessary, and the utility re-connected. An anti-seep collar should extend at least 2 feet all around the utility pipe or conduit. The excavated trench should then be backfilled with soil-bentonite slurry mixed in a steel muck box with a backhoe until a slump of approximately 8 inches is achieved. After the soil-bentonite is in place, the plates should be extracted." During the course of the project, Montgomery Watson, eliminated the 1 and 2 inch diameter utility crossings at the east end of the SBW

alignment. At the west end of the SBW alignment, only the existing future utility line stub under the railroad tracks was repaired so that it crossed the slurry wall at a depth of approximately 3½ feet below grade. The utility lines eliminated by Montgomery Watson were capped off by fusing end caps on the lines at the north side of the separation barrier wall. The lines on the south side of the separation barrier wall were not capped. The contractor then mixed 700 pounds and 1400 pounds of Hydrogel 90™ bentonite with the excavated soils at the west and east end utility crossing, respectively. It should be noted that the crossing is located approximately 3½ below grade and the water table was encountered 5 to 6 feet below grade.

Construction Documentation and Photos

A senior engineer with Hanson Engineering, P.C. was on site full time during the construction of the SBW. Daily field reports were prepared which documented each day activities. Daily field reports were numbered sequentially for all work performed at the site. It should be noted that daily field reports for the separation barrier wall are numbered 9 through 26. Daily field report numbers 1 through 8 and 27 through 37 are for groundwater extraction trench installations. For completeness we have included all of the daily field reports numbers 1 through 37 in this submittal. Copies of the daily field reports are attached in Appendix E.

Photographs were also taken as part of the construction documentation activities. Color copies of the photographs taken during this project are included herewith as Appendix F. We have also prepared a written Log of Photographs, which describes each photo. The Log of Photographs is also included in Appendix F.

Engineer's Statement of Compliance

This document and the testing program performed as part of this project have been prepared under the direction of this writer who is a licensed professional engineering in the State of Indiana. It is my opinion that the SBW at the ACS Cleanup site has been constructed in conformance with the design for the SBW wall. The results of the laboratory testing program indicate that the demonstrated hydraulic permeability of the soil-bentonite mixture in the SBW is less than 1×10^{-7} cm/sec and that the wall system should maintain this hydraulic conductivity value for the design life of ten years. The wall has been keyed into the underlying clay deposit for a distance of at least two feet along its alignment. The fact that the SBW could not be connected to the perimeter wall system may result in increased seepage around the ends of the wall system. The amount of seepage that can flank the wall will be limited and should not seriously impact the ability to lower the water level on either side of the SBW except in the immediate area of the wall ends.

"To the best of my knowledge, after thorough investigation, I certify that the information contained in or accompanying this submission is true, accurate and complete. I am aware that

there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

It is hoped that this information is sufficient to fulfill your present requirements. Should you have any questions or require additional information, please do not hesitate to call.

Respectfully submitted,
HANSON ENGINEERING, P.C.

Susan H. Bertram
Senior Engineer

Daniel L. Hanson, P.E.
Principal Engineer

APPENDIX B

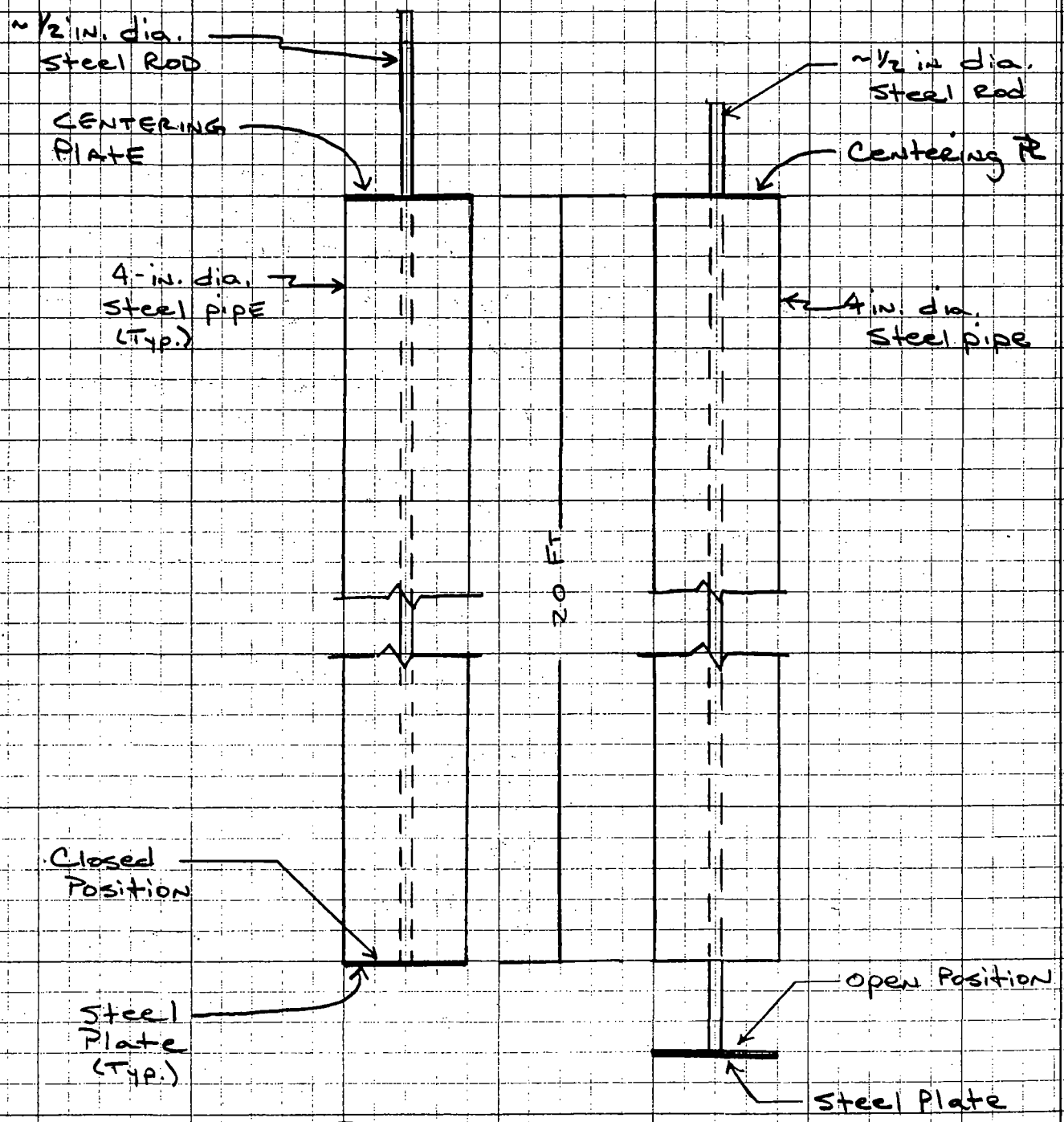
Field Records
(Hanson Engineering)

Sketch of Sampling Device

HANSON ENGINEERING P.C.
Soils, Foundations & Underground Specialists

9366 LILLEY ROAD
PLYMOUTH, MI 48170
(734) 454-6560
FAX (734) 454-7423

JOB ACS Cleanup — PROJECT NO. 00192-011 — SHEET NO. 1
SUBJECT — BY SHB — DATE 3/19/01
CHK. BY — DATE



PISTON TYPE SAMPLER
N.T.S.

Trench Depth Field Records

HANSON ENGINEERING P.C.
Soils, Foundations & Underground Specialists

OBSERVATION OF TRENCH DEPTH

Project Name ACS Separation Barrier Wall Project Number: 00192-011

Project Location: Griffith, Indiana

Date/ Time	Station	Instrument Elevation	Elevation of Reference on Trencher	Depth to Bottom of Trencher Boom *	Bottom Elevation of Trench *	Elevation of Instrument	Length of Probe	Bottom Elevation of Trench **
1/23/01 9:00 AM	6+65	644.75	+3 1/2"	27.29	617.46			
1/23/01 9:30 AM	6+80	644.75	-54"	22.5	622.25			
1/23/01 9:40 AM	6+75	644.75	-50"	22.83	621.92			
1/23/01 10:00 AM	6+55	644.75	+8"	27.66	617.08			
1/23/01 10:20 AM	6+45	644.75	+20 1/4"	28.69	616.06			
1/23/01 11:00 AM	6+35	644.75	+19 3/4"	28.65	616.10			
1/23/01 11:30 AM	6+25	644.75	+26 1/4"	29.19	615.56			
1/23/01 2:30 PM	6+15	644.70	+23 1/4"	28.94	615.76			

* Determine at 10' Intervals

** Determine at 3 locations along trench alignment

HANSON ENGINEERING P.C.
Soils, Foundations & Underground Specialists

OBSERVATION OF TRENCH DEPTH

Project Name ACS Separation Barrier Wall Project Number: 00192-011

Project Location: Griffith, Indiana

Date/ Time	Station	Instrument Elevation	Reference on Trencher	Depth to Bottom of Trencher Boom *	Bottom Elevation of Trench *	Elevation of Instrument	Length of Probe	Bottom Elevation of Trench **
1/23/01 3:00 PM	6+05	644.70	+25"	29.08	615.62			
1/23/01 3:30 PM	5+95	644.70	+25 ½"	29.13	615.58			
1/23/01 3:45 PM	5+85	644.70	+24"	29.0	615.7			
1/23/01 4:00 PM	5+75	644.70	+25 3/4"	29.15	615.55	644.05	29.53	614.52
1/24/01 10:00 AM	5+75	643.35	+12"	28.0	615.35			
1/24/01 10:15 AM	5+65	643.35	+14 1/2"	28.21	615.14			
1/24/01 10:53 AM	5+55	643.35	+16"	28.33	615.01			

* Determine at 10' Intervals

** Determine at 3 locations along trench alignment

HANSON ENGINEERING P.C.
Soils, Foundations & Underground Specialties

OBSERVATION OF TRENCH DEPTH

Project Name ACS Separation Barrier Wall Project Number: 00192-011

Project Location: Griffith, Indiana

Date/ Time	Station	Instrument Elevation	Reference on Trencher	Depth to Bottom of Trencher Boom *	Bottom Elevation of Trench *	Elevation of Instrument	Length of Probe	Bottom Elevation of Trench **
1/24/01 11:15 AM	5+45	643.35	19 3/4"	28.65	614.70			
1/24/01 1:30 AM	5+35	643.35	22 1/4"	28.85	614.5			
1/29/01	5+25	643.21	20 5/8"	28.71	614.5			
1/29/01	5+15	643.27	20 5/8"	28.71	614.5			
1/29/01	5+05	643.21	24"	29.0	614.21			
1/29/01	4+95	643.21	24"	29.0	614.21			
1/29/01	4+85	643.21	20"	28.67	614.5			
1/29/01	4+75	643.21	20"	28.67	614.5			

* Determine at 10' Intervals

** Determine at 3 locations along trench alignment

HANSON ENGINEERING P.C.
Soils, Foundations & Underground Specialists

OBSERVATION OF TRENCH DEPTH

Project Name ACS Separation Barrier Wall Project Number: 00192-011

Project Location: Griffith, Indiana

Date/ Time	Station	Ground Surface Elevation	Reference on Trencher	Depth to Bottom of Trencher Boom *	Bottom Elevation of Trench *	Elevation of Instrument	Length of Probe	Bottom Elevation of Trench **
1/29/01	4+65	639.43	2.0'	25.0	614.43			
1/29/01	4+55	639.40	2.0'	25.0	614.40			
1/29/01	4+45	639.19	2.0'	25.0	614.19			
1/29/01	4+35	639.24	2.5'	24.5	614.74			
1/29/01	4+25	639.21	2.5'	24.5	614.71			
1/29/01	4+15	639.27	2.5'	24.5	614.77			
1/29/01	4+05	639.25	2.5'	24.5	614.75			
1/29/01	3+95	639.13	2.5'	24.5	614.63			

* Determine at 10' Intervals
** Determine at 3 locations along trench alignment

HANSON ENGINEERING P.C.
Soils, Foundations & Underground Specialists

OBSERVATION OF TRENCH DEPTH

Project Name ACS Separation Barrier Wall Project Number: 00192-011

Project Location: Griffith, Indiana

Date/ Time	Station	Ground Surface Elevation	Reference on Trencher	Depth to Bottom of Trencher Boom *	Bottom Elevation of Trench *	Elevation of Instrument	Length of Probe	Bottom Elevation of Trench **
1/30/01	3+85	638.93	3.0'	24.0	614.93			
1/30/01 9:25 AM	3+75	638.85	3.35'	23.65	615.2			
1/30/01	3+65	638.79	3.5'	23.5	615.29			
1/30/01 10:30 AM	3+55	638.77	3.5'	23.5	615.27			
1/31/01	3+45	638.67	4.0'	23.0	615.67	645.30	29.44	615.86
1/31/01	3+35	638.45	4.0'	23.0	615.45			
1/31/01	3+25	638.25	4.0'	23.0	615.25			
1/31/01	3+15	638.17	4.0'	23.0	615.17			

* Determine at 10' Intervals

** Determine at 3 locations along trench alignment

HANSON ENGINEERING P.C.
Soils, Foundations & Underground Specialists

OBSERVATION OF TRENCH DEPTH

Project Name ACS Separation Barrier Wall Project Number: 00192-011

Project Location: Griffith, Indiana

Date/ Time	Station	Instrument Elevation	Reference on Trencher	Depth to Bottom of Trencher Boom *	Bottom Elevation of Trench *	Elevation of Top of Probe	Length of Probe	Bottom Elevation of Trench **
1/31/01	3+05	638.17	4.0'	23.0	615.17			
1/31/01	2+95	637.97	4.0'	23.0	614.97			
1/31/01	2+85	637.79	4.0'	23.0	614.79			
1/31/01	2+75	637.99	3.25'	23.75	614.74			
1/31/01	2+65	638.11	3.5'	23.5	614.61			
1/31/01	2+55	638.21	3.5'	23.5	614.71			
1/31/01	2+45	639.21	3.5'	23.5	615.71			
1/31/01	2+35	638.17	3.5'	23.5	614.67			

* Determine at 10' Intervals
** Determine at 3 locations along trench alignment

HANSON ENGINEERING P.C.
Soils, Foundations & Underground Specialists

OBSERVATION OF TRENCH DEPTH

Project Name ACS Separation Barrier Wall Project Number: 00192-011

Project Location: Griffith, Indiana

Date/ Time	Station	Instrument Elevation	Reference on Trencher	Depth to Bottom of Trencher Boom *	Bottom Elevation of Trench *	Elevation of Top of Probe	Length of Probe	Bottom Elevation of Trench **
1/31/01	2+25	637.87	3.5'	23.5	614.37			
1/31/01	2+15	639.31	3.0'	24.0	615.31			
1/31/01	2+05	638.87	4.0'	23.0	615.87			
1/31/01	1+95	638.23	4.25'	22.75	615.48			
1/31/01	1+85	638.21	4.0'	23.0	615.21			
1/31/01	1+75	638.11	4.0'	23.0	615.11			
1/31/01	1+65	638.20	3.5'	23.5	614.7			
1/31/01	1+55	637.99	3.5'	23.5	614.49			

* Determine at 10' Intervals
** Determine at 3 locations along trench alignment

HANSON ENGINEERING P.C.
Soils, Foundations & Underground Specialists

OBSERVATION OF TRENCH DEPTH

Project Name ACS Separation Barrier Wall Project Number: 00192-011

Project Location: Griffith, Indiana

Date/ Time	Station	Ground Surface Elevation	Elevation of Reference on Trencher	Depth to Bottom of Trencher Boom *	Bottom Elevation of Trench *	Elevation of Top of Probe	Length of Probe	Bottom Elevation of Trench **
1/31/01	1+45	638.01	3.0'	24.0	614.01			
1/31/01	1+35	638.07	2.5'	24.5	613.57			
1/31/01	1+25	638.29	2.5'	24.5	613.79			
1/31/01	1+15	638.13	2.5'	24.5	613.63	645.30	31.81'	613.49
1/31/01	1+05	637.15	2.5'	24.5	613.65			
1/31/01	0+95	638.10	3.0'	24.0	614.10			
1/31/01	0+85	638.25	3.0'	24.0	614.25			
1/31/01	0+75	638.11	3.0'	24.0	614.11			

* Determine at 10' Intervals
** Determine at 3 locations along trench alignment

HANSON ENGINEERING P.C.
Soils, Foundations & Underground Specialists

OBSERVATION OF TRENCH DEPTH

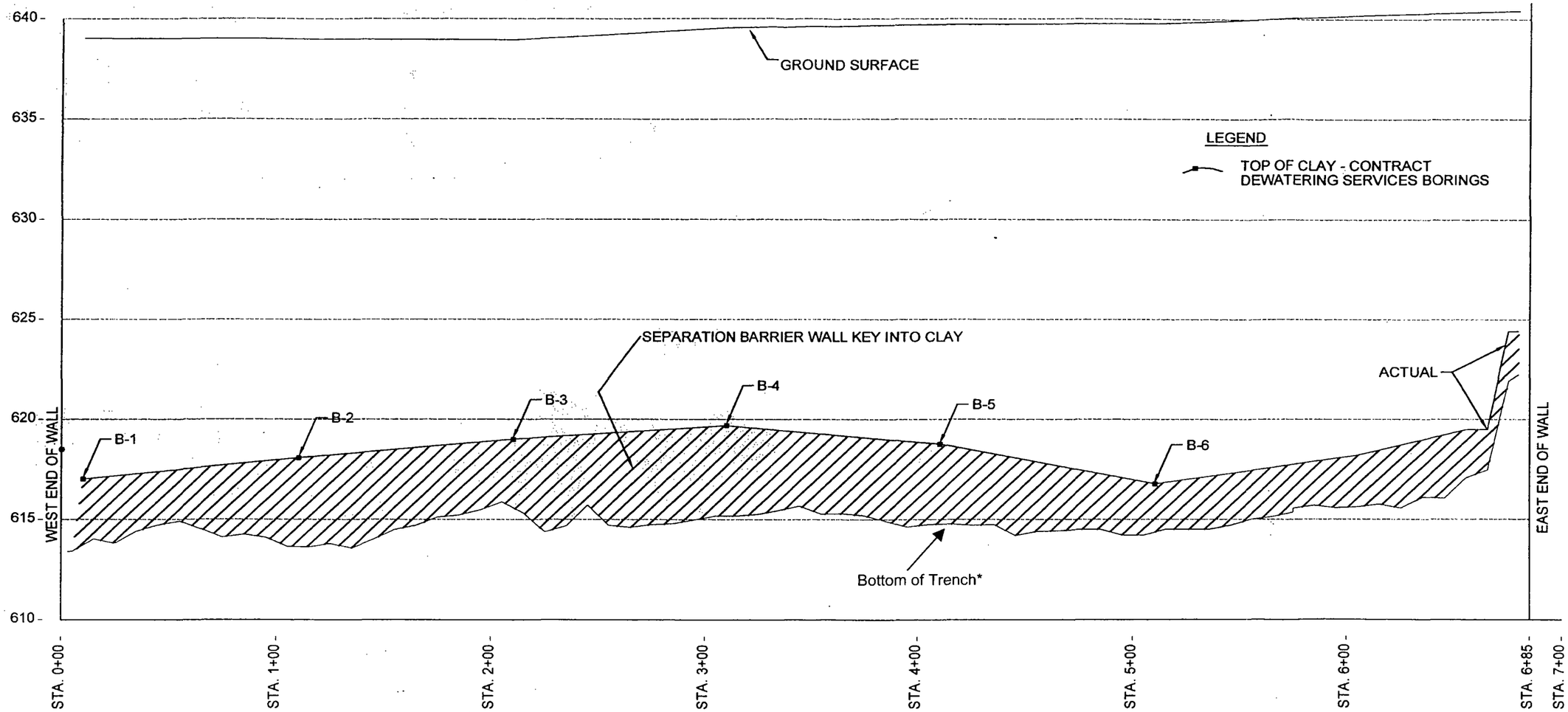
Project Name ACS Separation Barrier Wall Project Number: 00192-011

Project Location: Griffith, Indiana

Date/ Time	Station	Ground Surface Elevation	Elevation of Reference on Trencher	Depth to Bottom of Trencher Boom *	Bottom Elevation of Trench *	Elevation of Top of Probe	Length of Probe	Bottom Elevation of Trench **
1/31/01	0+65	638.03	3.5'	23.5	614.53			
1/31/01	0+55	638.41	3.5'	23.5	614.91			
1/31/01	0+45	638.23	3.5'	23.5	614.73			
2/1/01	0+35	638.40	3.0'	24.0	614.4			
2/1/01	0+25	637.81	3.0'	24.0	613.81			
2/1/01	0+15	638.02	3.0'	24.0	614.02			
2/1/01	0+05	637.41	3.0'	24.0	613.41			
2/1/01	0+03	637.40	3.0'	24.0	613.40			

* Determine at 10' Intervals
** Determine at 3 locations along trench alignment

Drawing of Separation Barrier Wall Key into Clay Layer



SBW-KEY INTO CLAY
ELEVATION VIEW
SCALE: 1" = 50' HOR
1" = 5' VER

*Added by MWH - 2/14/02

SBW–KEY INTO CLAY LAYER
ASC CLEAN–UP PROJECT
GRIFFITH, INDIANA

SCALE: AS SHOWN	APPROVED BY: DANIEL L. HANSON, P.E.
DATE: 19 MAR 01	DRAWN BY: KAM
PREPARED FOR: CONTRACT DEWATERING, INC. 5820 W. RIVERSIDE DRIVE, BOX 1 SARANAC, MI 48881	REVISED BY / DATE

HANSON ENGINEERING, P.C.
9366 LILLEY ROAD
PLYMOUTH, MICHIGAN 48170
Phone: (734) 454–6560 Fax: (734) 454–7423

DRAWING NUMBER: 00192-011-A

Daily Air Monitoring Logs

Barrier Wall Starter Trench Installation

HANSON ENGINEERING P.C.
Soils, Foundations & Underground Specialists

PROJECT: **ACS Clean-up Site**
PROJECT NO.: **00192-011**
LOCATION: **Griffith, Indiana**
CLIENT: Contract Dewatering Services
CONTRACTORS: Contract Dewatering Services

DATE: 1/9/01
WEATHER: Sunny, 30F
REPORT NO: 9a
SHEET 1 OF 1

Client's representative: John Flak
Contractor's representative: John Flak

Location	Time	PID Readings (ppm)			Remarks
		G.S.	5 ft.	10 ft.	
	7:30				
	8:00				
	8:30				
	9:00				
	9:30				
	10:00				
	10:30				
	11:00				
	11:30				
	12:00				
	12:30				
	13:00				
PE-Photovac PID	13:30	0	0	0	
~STA 7+00	14:00	0	0	0	
STA 6+50	14:30	0	0	0	
STA 6+00	15:00	0	0	0	
STA 5+50	15:30	0	0	0	
	16:00				
	16:30				
	17:00				
	17:30				

Barrier Wall Starter Trench Installation

HANSON ENGINEERING P.C.
Soils, Foundations & Underground Specialists

PROJECT: **ACS Clean-up Site**
PROJECT NO.: **00192-011**
LOCATION: **Griffith, Indiana**
CLIENT: Contract Dewatering Services
CONTRACTORS: Contract Dewatering Services

DATE: 1/10/01
WEATHER: Sunny, Windy 37F
REPORT NO: 10a
SHEET 1 OF 1

Client's representative: John Flak
Contractor's representative: John Flak

Location	Time	PID Readings (ppm)			Remarks
		G.S.	5 ft.	10 ft.	
	7:30				
Calibration	8:00	0	0	0	
	8:30				
	9:00				
	9:30				
	10:00				
STA 5+00	10:30	0	0	0	
STA 4+00	11:00	0	0	0	
STA 3+00	11:30	0	0	0	
STA 3+50	12:00	0	0	0	
Lunch	12:30	-	-	-	
STA 2+00	13:00	0	0	0	
STA 1+00	13:30	0	0	0	
STA 0+50	14:00	0	0	0	
STA 0+00	14:30	0	0	0	
	15:00	-	-	-	
	15:30				
	16:00				
	16:30				
	17:00				
	17:30				

Barrier Wall Starter Trench Installation

HANSON ENGINEERING P.C.
Soils, Foundations & Underground Specialists

PROJECT: **ACS Clean-up Site**
PROJECT NO.: **00192-011**
LOCATION: **Griffith, Indiana**
CLIENT: Contract Dewatering Services
CONTRACTORS: Contract Dewatering Services

DATE: 1/17101
WEATHER: Cloudy 28F
REPORT NO: 12a
SHEET 1 OF 1

Client's representative: John Flak
Contractor's representative: John Flak

Location	Time	PID Readings (ppm)			Remarks
		G.S.	5 ft.	10 ft.	
	7:30				
	8:00				
	8:30				
	9:00				
	9:30				
	10:00				
	10:30				
6+80 start	11:00	0	0	0	Locating existing
6+80	11:30	0	0	0	SBW east end
6+80	12:00	0	0	0	"
Lunch	12:30				
6+80	13:00	0	0	0	Locating Utilities
6+60	13:30	0	0	0	east end
6+60	14:00	0	0	0	"
6+80	14:30	0	0	0	"
0+00	15:00	0	0	0	Locating Utilities
0+10	15:30	0.2	0.2	0.2	west end
0+05	16:00	0.4	0.2	0	"
	16:30				
	17:00				
	17:30				

Barrier Wall Starter Trench Installation

HANSON ENGINEERING P.C.
Soils, Foundations & Underground Specialists

1/18/01

PROJECT: **ACS Clean-up Site**
PROJECT NO.: **00192-011**
LOCATION: **Griffith, Indiana**
CLIENT: Contract Dewatering Services
CONTRACTORS: Contract Dewatering Services

DATE: 1/~~17~~101
WEATHER: P. Sunny 28F
REPORT NO: 13a
SHEET 1 OF 1

Client's representative: John Flak
Contractor's representative: John Flak

Location	Time	PID Readings (ppm)			Remarks
		G.S.	5 ft.	10 ft.	
	7:30				
	8:00				
6+90	8:30	0	0	0	Expose utility lines
6+90	9:00	0	0	0	further north at
6+90	9:30	0	0	0	east end of SBW
6+90	10:00	0	0	0	alignment
	10:30				
	11:00				
	11:30				
	12:00				
	12:30				
	13:00				
	13:30				
	14:00				
	14:30				
	15:00				
	15:30				
	16:00				
	16:30				
	17:00				
	17:30				

Barrier Wall Starter Trench Installation

HANSON ENGINEERING P.C.
Soils, Foundations & Underground Specialists

PROJECT: **ACS Clean-up Site**
PROJECT NO.: **00192-011**
LOCATION: **Griffith, Indiana**
CLIENT: Contract Dewatering Services
CONTRACTORS: Contract Dewatering Services

DATE: 1/19/01
WEATHER: Snow 26F
REPORT NO: 14a
SHEET 1 OF 1

Client's representative: Barry Medford
Contractor's representative: Barry Medford

Location	Time	PID Readings (ppm)			Remarks
		G.S.	5 ft.	10 ft.	
	7:30				
	8:00				
Background	8:30	0	0	0	
6+82	9:00	0	0	0	
6+82	9:30	0	0	0	
	10:00				
	10:30				
	11:00				
	11:30				
	12:00				
	12:30				
	13:00				
	13:30				
	14:00				
	14:30				
	15:00				
	15:30				
	16:00				
	16:30				
	17:00				
	17:30				

Barrier Wall Starter Trench Installation

HANSON ENGINEERING P.C.
Soils, Foundations & Underground Specialists

PROJECT: **ACS Clean-up Site**
PROJECT NO.: **00192-011**
LOCATION: **Griffith, Indiana**
CLIENT: Contract Dewatering Services
CONTRACTORS: Contract Dewatering Services

DATE: 1/23/01
WEATHER: Sunny, 34F
REPORT NO: 15a
SHEET 1 OF 1

Client's representative: John Flak
Contractor's representative: John Flak

Location	Time	PID Readings (ppm)			Remarks
		G.S.	5 ft.	10 ft.	
	7:30				
Background	8:00	0	0	0	
STA 6+60	8:30	0	0	0	
STA 6+65	9:00	0.2	0.1	0.1	
STA 6+80	9:30	0.4	0.3	0.3	
STA 6+50	10:00	0.3	0.3	0.3	
STA 6+42	10:30	0.3	0.3	0.3	
STA 6+34	11:00	0.2	0.2	0.2	
STA 6+25	11:30	0.2	0.3	0.3	
Lunch	12:00	-	-	-	
Lunch	12:30	-	-	-	
STA 6+80	13:00	0.2	0.2	0.2	
STA 6+80	13:30	0.2	0.2	0.2	
No Reading	14:00	-	-	-	
No Reading	14:30	-	-	-	
STA 6+00	15:00	0.3	0.4	0.4	
STA 5+90	15:30	0.3	0.3	0.3	
STA 5+80	16:00	0.3	0.3	0.3	
	16:30				
	17:00				
	17:30				

Barrier Wall Starter Trench Installation

HANSON ENGINEERING P.C.
Soils, Foundations & Underground Specialists

PROJECT: **ACS Clean-up Site**
PROJECT NO.: **00192-011**
LOCATION: **Griffith, Indiana**
CLIENT: Contract Dewatering Services
CONTRACTORS: Contract Dewatering Services

DATE: 1/24/01
WEATHER: Sunny, 24F
REPORT NO: 16a
SHEET 1 OF 1

Client's representative: John Flak
Contractor's representative: John Flak

Location	Time	PID Readings (ppm)			Remarks
		G.S.	5 ft.	10 ft.	
	7:30				
Background	8:00	0	0	0	
No trenching	8:30	-	-	-	
No trenching	9:00	-	-	-	
5+75	9:30	0.1	0.1	0.1	
5+70	10:00	0.1	0.2	0.2	
5+70	10:30	0.2	0.3	0.3	
5+63	11:00	0.2	0.3	0.3	
5+40	11:30	6.0	6.0	0.4	
Lunch	12:00	-	-	-	
Lunch	12:30	-	-	-	
5+40	13:00	0.2	0.2	0.0	
5+35	13:30		50.0		30 feet downwind
	14:00				shut down trenching
	14:30				operations
	15:00				
	15:30				
	16:00				
	16:30				
	17:00				
	17:30				

Barrier Wall Starter Trench Installation

HANSON ENGINEERING P.C.
Soils, Foundations & Underground Specialists

PROJECT: **ACS Clean-up Site**
PROJECT NO.: **00192-011**
LOCATION: **Griffith, Indiana**
CLIENT: Contract Dewatering Services
CONTRACTORS: Contract Dewatering Services

DATE: 1/29/01
WEATHER: Rain 34-38F
REPORT NO: 19a
SHEET 1 OF 1

Client's representative: Barry Medford
Contractor's representative: Barry Medford

Location	Time	PID Readings (ppm)			Remarks
		G.S.	5 ft.	10 ft.	
	7:30				
	8:00				
	8:30				
	9:00				
	9:30				
STA 4+85	10:00	20	20	20	
STA 4+75	10:30	200	200	200	
STA 4+65	11:00	50	50	50	
STA 4+35	11:30		70	70	
STA 4+30	12:00		15	15	
Lunch	12:30				
STA 4+30	13:00		15	15	Reading from operator
STA 4+25	13:30		10	10	"
STA4+20	14:00		5	5	"
STA 4+05	14:30		2	2	"
STA 3+95	15:00				
	15:30				
	16:00				
	16:30				
	17:00				
	17:30				

HANSON ENGINEERING P.C.
Soils, Foundations & Underground Specialists

PROJECT: **ACS Clean-up Site**
PROJECT NO.: **00192-011**
LOCATION: **Griffith, Indiana**
CLIENT: Contract Dewatering Services
CONTRACTORS: Contract Dewatering Services

DATE: 1/30/01
WEATHER: Rain 36-40 F
REPORT NO: 20a
SHEET 1 OF 1

Client's representative: Barry Medford
Contractor's representative: Barry Medford

Location	Time	PID Readings (ppm)			Remarks
		G.S.	5 ft.	10 ft.	
Zeroing	7:30		0	0	
STA 3+95	8:00		3	3	
STA 3+85	8:30		5	5	
STA 3+80	9:00		5.0	5.0	
STA 3+75	9:30		4.0	4.0	
STA 3+65	10:00		3	3	
STA 3+60	10:30		5	5	
	11:00				Instrument HNU PID
	11:30				broke down due to
	12:00				vibrations in trencher.
	12:30				
	13:00				
	13:30				
	14:00				
	14:30				
	15:00				
	15:30				
	16:00				
	16:30				
	17:00				
	17:30				

HANSON ENGINEERING P.C.
Soils, Foundations & Underground Specialists

PROJECT: **ACS Clean-up Site**
PROJECT NO.: **00192-011**
LOCATION: **Griffith, Indiana**
CLIENT: Contract Dewatering Services
CONTRACTORS: Contract Dewatering Services

DATE: 1/31/01
WEATHER: Cloudy 34 F
REPORT NO: 21a
SHEET 1 OF 1

Client's representative: Barry Medford
Contractor's representative: Barry Medford

Location	Time	PID Readings (ppm)			Remarks
		G.S.	5 ft.	10 ft.	
	7:30				
Zeroing	8:00		0	0	
STA 3+55	8:30		0	0	
STA 3+35	9:00		1.1	1.1	
STA 2+95	9:30		2.0	2.0	
STA 2+55	10:00		3.3	3.3	
STA 2+35	10:30		3.0	3.0	
STA 2+15	11:00		2.6	2.6	
STA 1+95	11:30		3.1	3.1	
Lunch	12:00				
Lunch	12:30				
STA 1+85	13:00		3.4	3.4	
STA 1+65	13:30		3.4	3.4	
STA 1+45	14:00		2.4	2.4	
STA 1+25	14:30		2.9	2.9	
STA 1+00	15:00		3.2	3.2	
STA 0+75	15:30		1.7	1.7	
STA 0+45	16:00		2.3	2.3	
	16:30				
	17:00				
	17:30				

HANSON ENGINEERING P.C.
Soils, Foundations & Underground Specialists

PROJECT: **ACS Clean-up Site**
PROJECT NO.: **00192-011**
LOCATION: **Griffith, Indiana**
CLIENT: Contract Dewatering Services
CONTRACTORS: Contract Dewatering Services

DATE: 2/1/01
WEATHER: Sunny 26F
REPORT NO: 22a
SHEET 1 OF 1

Client's representative: Barry Medford
Contractor's representative: Barry Medford

Location	Time	PID Readings (ppm)			Remarks
		G.S.	5 ft.	10 ft.	
	7:30				
STA 0+45	8:00	0	0		Trencher Repairs
"	8:30	0	0		"
"	9:00	0	0		"
"	9:30	0	0		"
"	10:00	0	0		"
"	10:30	0	0		"
"	11:00	0	0		"
	11:30				"
	12:00				"
STA 0+45	12:30	0	0		"
"	13:00	0	0		"
"	13:30	0	0		"
"	14:00	0	0		"
"	14:30	0	0		"
STA 0+40	15:00	0	0	0	Trenching
STA 0+20	15:30		0	0	
STA 0+05	16:00		0	0	
	16:30				
	17:00				
	17:30				

Separation Barrier Wall

HANSON ENGINEERING P.C.
Soils, Foundations & Underground Specialists

2/2/01

PROJECT: **ACS Clean-up Site**
PROJECT NO.: **00192-011**
LOCATION: **Griffith, Indiana**
CLIENT: Contract Dewatering Services
CONTRACTORS: Contract Dewatering Services

DATE: ~~2/5~~/01
WEATHER: Cold -1 F
REPORT NO: 23a
SHEET 1 OF 1

Client's representative: Richard Neumann
Contractor's representative: Richard Neumann

Location	Time	PID Readings (ppm)			Remarks
		G.S.	5 ft.	10 ft.	
	7:30				
Decon Area	8:00	0	0		
"	8:30	0	0		
"	9:00	0	0		
"	9:30	0	0		
"	10:00	0	0		
STA 2+95	10:30	0	0		
"	11:00	0	0		
"	11:30	0	0		
"	12:00	0	0		
"	12:30	0	0		
"	13:00	0	0		
	13:30				
	14:00				
	14:30				
	15:00				
	15:30				
	16:00				
	16:30				
	17:00				
	17:30				

HANSON ENGINEERING P.C.
Soils, Foundations & Underground Specialists

PROJECT: **ACS Clean-up Site**
PROJECT NO.: **00192-011**
LOCATION: **Griffith, Indiana**
CLIENT: Contract Dewatering Services
CONTRACTORS: Contract Dewatering Services

DATE: 2/5/01
WEATHER: Cloudy 34 F
REPORT NO: 24a
SHEET 1 OF 1

Client's representative: Barry Medford
Contractor's representative: Barry Medford

Location	Time	PID Readings (ppm)			Remarks
		G.S.	5 ft.	10 ft.	
	7:30				
	8:00				
	8:30				
Decon. Area	9:00	0	0		
Decon. Area	9:30	0	0		
Decon. Area	10:00	0	0		
	10:30				
	11:00				
	11:30				
	12:00				
	12:30				
	13:00				
	13:30				
	14:00				
	14:30				
	15:00				
	15:30				
	16:00				
	16:30				
	17:00				
	17:30				

APPENDIX C

Photograph Log
(MWH)

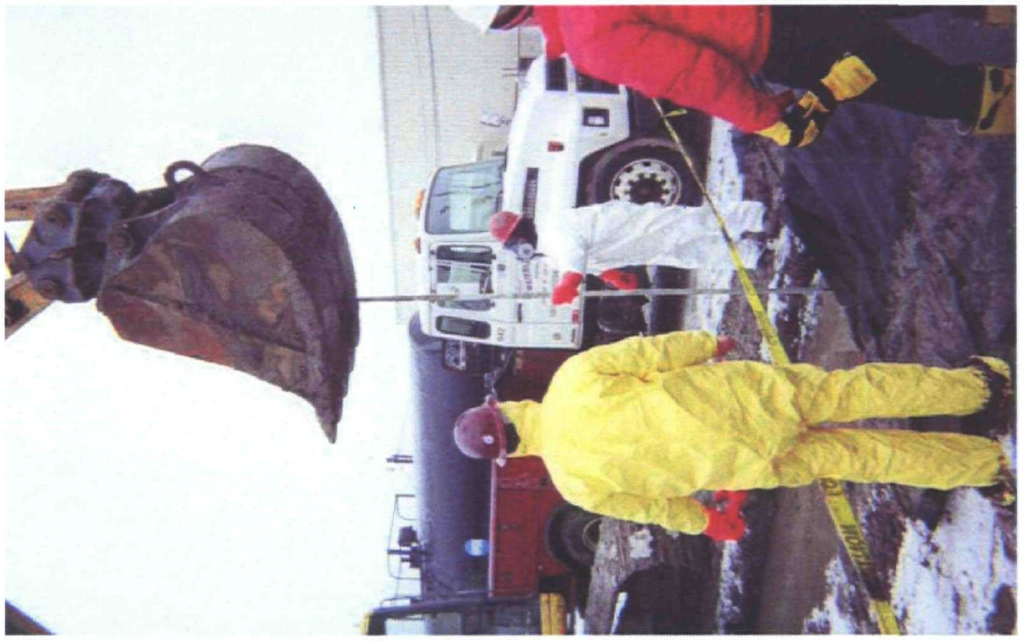
1. January 9, 2001 (Looking Northwest): Adding dry bentonite to the previously-excavated three foot deep trench along the alignment of Separation Barrier Wall.

2. January 23, 2001 (Looking Southwest): Lowering the trencher into the ground and beginning to trench.

3. January 23, 2001 (Looking West): Front view of the trencher at rest.

4. January 23, 2001 (Looking West): Conducting regular air monitoring near the trencher and around the perimeter of the site.

5. January 23, 2001 (Looking Southwest): As water is added to the dry bentonite powder, the trencher thoroughly mixes the slurry.



6. January 23, 2001 (Looking North): At regular intervals, the depth of the trench is physically confirmed by inserting a steel conduit probe into the trench.

7. January 24, 2001 (Looking West): As the trencher moves along, the elevation of the trencher boom is regularly recorded.

8. January 24, 2001 (Looking North): A white carpenter's ruler is attached to the trencher boom to determine its elevation. It is a known distance from the bottom of the carpenter's ruler to the bottom of the trench.

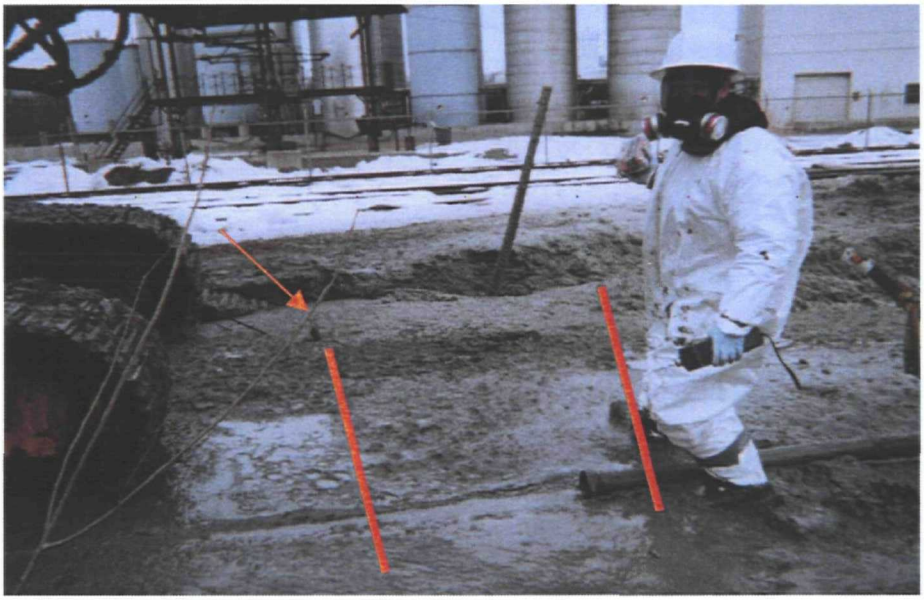
9. January 29, 2001 (Looking West): A view of the exclusion zone.

10. January 29, 2001 (Looking to the west): A view of trencher.

11. January 25, 2001 (Looking Northwest): At regular intervals, slurry samples are extracted from the trench at a depth of 12 to 15 feet using a large steel pipe with a plunger mechanism.

12. January 25, 2001 (Looking North): Typical field tests: preparing the slump test.

13. January 31, 2001 (Looking North): Measuring the results of the slump test.



14. February 1, 2001 (Looking North): The trencher stops three feet short of the existing HDPE barrier wall (station 0+00) as planned. The red arrow points to the short stake which marks the HDPE barrier wall location. The engineer's foot marks the location where the trencher stopped trenching.

15. February 5, 2001 (Looking North): Typical decontamination procedures.

Note: Dates listed are approximate

APPENDIX D

Pre-Construction Investigation

Summary of Test Borings
(Contract Dewatering Services, Inc.)

CONTRACT DEWATERING SERVICES, INC

Memo

Kick off meeting 11/29/00 1PM @ MW. Napolitano

To: Dick

From: John Flak

CC:

Date: 11/26/00

Re: Griffith, Indiana

01/11/01

Dick:

On 11/21/00 test borings were made at the above referenced site to determine the elevation and characteristics of the clay. The results are as follows: Clay El.

#1 - Taken 10 feet east of the west end of wall – WL –3 – Gray Fine sand with clay @ minus 22 617.02

#2 - Taken 100 feet east of boring #1 – WL –3 – Gray Fine sand with clay @ minus 20-22 618.08

#3 - Taken 100 feet east of boring #2 – WL –3 – Gray Fine sand with clay @ minus 20 – Sample of clay and silty clay taken at minus 20 and minus 19. 619.0

#4 - Taken 100 feet east of Boring #3 – WL –4 – Gray Fine sand with clay @ minus 20 619.69

#5 - Taken 100 feet east of Boring #4 – WL –4 – Gray Fine sand with clay @ minus 21 618.76

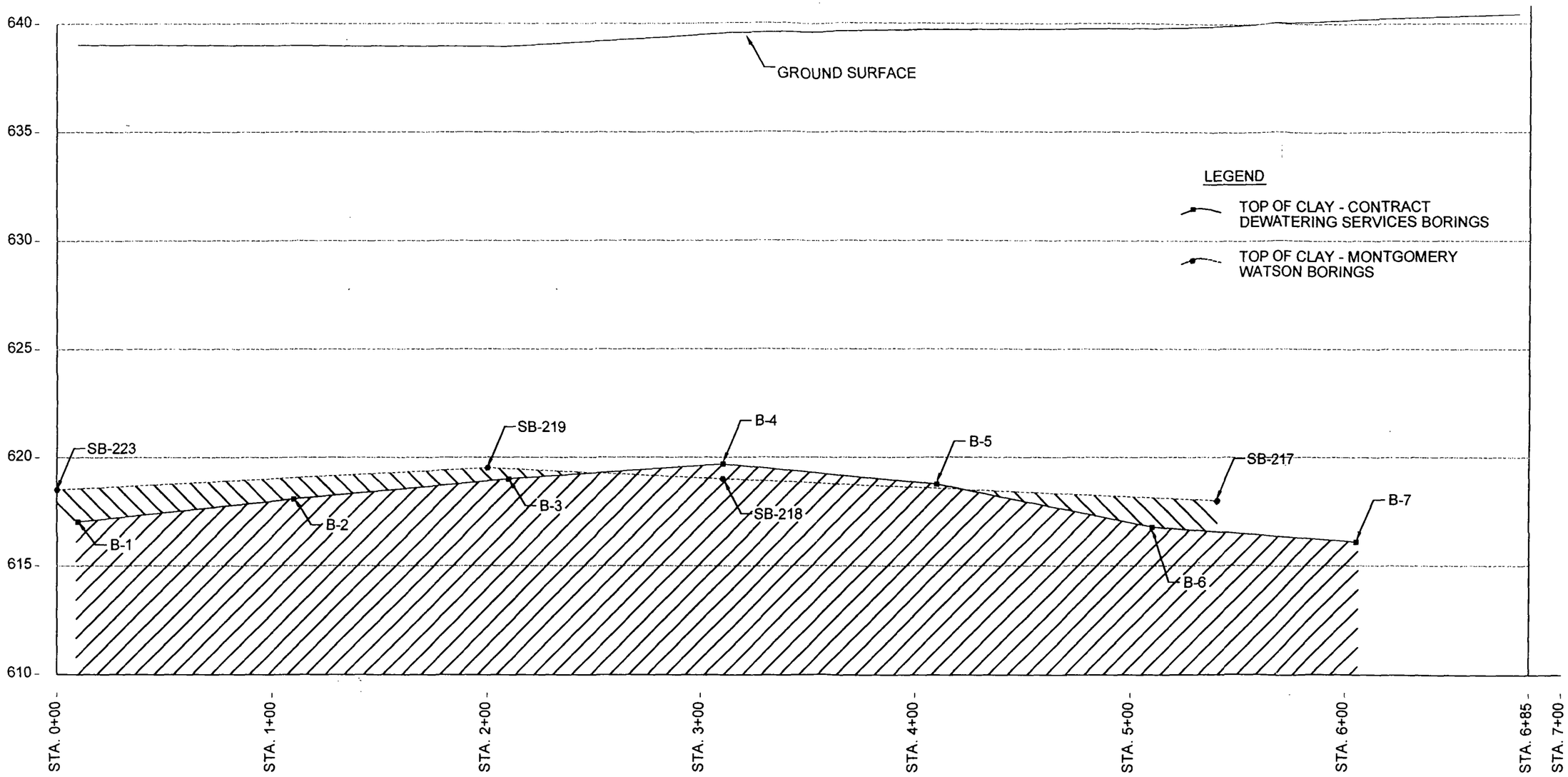
#6 - Taken 100 feet east of Boring #5 – WL – 4 – Gray Fine sand with clay @ minus 23 616.78

#7 - Taken 100 feet east of Boring #6 – WL – 5 – Gray fine sand with clay @ minus 24 616.10

Boring #7 was 70 from the end of the wall as marked by MW (Tim) – The length of the wall at the time of the testing was 690 feet.

I am meeting the fence people on site on Monday the 27th to agree on the value of their contract and to begin removing the fence. I am going to have the fence removed to 30 feet beyond the West end of the slurry wall unless you advise differently. A Water sample was taken by Simalabs from the plant influent line. Also, 40 pounds of soil was collected in a plastic pail and subsequently delivered to Hanson on Tuesday evening. Hanson told Simalabs what to test for. Cost for water testing estimated at $600.00.

Drawing of Projected Top of Clay Layer
(Hanson Engineering)



SBW ALIGNMENT-TOP OF CLAY
ELEVATION VIEW
SCALE: 1" = 50' HOR
1" = 5' VER

SBW ALIGNMENT–TOP OF CLAY LAYER
ASC CLEAN–UP PROJECT
GRIFFITH, INDIANA

SCALE: AS SHOWN	APPROVED BY: DANIEL L. HANSON, P.E.	DRAWN BY: KAM
DATE: 19 MAR 01		REVISED BY:
PREPARED FOR: CONTRACT DEWATERING, INC. 5820 W. RIVERSIDE DRIVE, BOX 1 SARANAC, MI 48881		DATE:

HANSON ENGINEERING, P.C.
9366 LILLEY ROAD
PLYMOUTH, MICHIGAN 48170
Phone: (734) 454–6560 Fax: (734) 454–7423

DRAWING NUMBER: 00192-011-B

APPENDIX E

Manufacturer's Product Specification Sheets for Bentonite
(Contract Dewatering Services, Inc.)

TECHNICAL INFORMATION SHEET

WYO-BEN, INC.
550 South 24th Street West, Suite 201
P. O. Box 1979
Billings, Montana 59103
USA
Tel: 406~652-6351 / Fax: 406~656-0748

SUBJECT: **HYDROGEL®**

Sodium bentonite meeting all API Spec. 13A, Section 4 (Fourteenth Ed., May, 1993) requirements.

COLOR: Light Gray

TYPICAL CHEMICAL ANALYSIS:	%
SiO_2	61.4
Al_2O_3	18.1
Fe_2O_3	3.5
Na_2O	2.3
MgO	1.7
CaO	.4
TiO_2	.2
K_2O	.1
Other	.07
H_2O	7.8
L.O.I.	4.4

TRACE METALS:	P.P.M.
Arsenic	0.1
Barium	< 1.0
Cadmium	< 0.01
Chromium	< 0.05
Lead	< 0.1
Mercury	< 0.02
Selenium	< 0.02
Silver	< 0.05

SPECIFIC GRAVITY: 2.55 ± 0.1

pH (5% SUSPENSION): 9.1 ± 0.4

SURFACE AREA (m^2/gm):

External Surface	82
All Surfaces	800

BULK DENSITY (lbs/ft^3): 52 ± 3

PARTICLE SIZE:
% Passing 200 Mesh Sieve 80% ± 4

TYPICAL CHARACTERISTICS: Criteria (API 13A, Sec. 4 Spec)	Typical Test Results
Viscometer Reading @ 600 R.P.M. - (30 Minimum)	38 ± 4
Barrel Yield	98 ± 4
Water Loss (15.0 Maximum)	13.5 ± 1
Wet Screen Analysis Residue on U.S. Sieve No. 200 (4.0% Maximum)	3.0 ± 0.5
% Moisture	8 ± 2
Gel Strength (10 Seconds)	4 ± 1
Gel Strength (10 Minutes)	12 ± 2
Plastic Viscosity, cps.	13 ± 3
YP/PV Ratio (3.0 Maximum)	1.5 x P.V. ± 0.5
Marsh Funnel Viscosity (Sec.)	45 ± 2
Free Swell	22 Min.

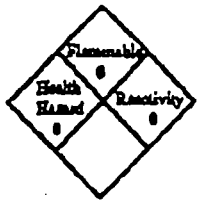
Viscosity, funnel viscosity, yield point, water loss and pH are determined using a suspension of 22.5 grams of bentonite in 350 ml. of distilled water, (6.1% by wt.)

USES:
Oil and gas, mineral and water well drilling, horizontal boring and tunneling, slurry wall construction.

Rev 6/99

WYO-BEN, INC.

MATERIAL SAFETY DATA SHEET



NFPA FIRE HAZARD IDENTIFICATION SYSTEM

I. PRODUCT IDENTIFICATION

Trade Name(s): **HYDROGEL®**

Generic Name(s): Wyoming (Western) Bentonite; Bentonite Clay (CAS No. 1302-78-9)

Chemical Name(s): Sodium Montmorillonite (CAS No. 1318-93-0)

Manufacturer: WYO-BEN, INC. Address: P.O. Box 1979 Billings, Montana 59103	Telephone Numbers: Information: (406) 652-6351 EMERGENCY: (406) 652-6351

II. HAZARDOUS INGREDIENTS

Ingredient	CAS NO.	%	Hazard
Crystalline Silica (SiO_2) as Quartz See Note	14808-60-7	See Note	Low concentrations of crystalline silica (SiO_2) in the form of quartz, may be present in airborne bentonite dust. See Section VI for discussion of health hazard.

Note: Although the typical quartz content of western bentonite is in the range of 2 to 6%, most of the quartz particles are larger than the 10 Φ respirable threshold size. The actual respirable quartz concentration in airborne bentonite dust will depend upon bentonite source, fineness of product, moisture content of product, local humidity and wind condition at point of use and other use specific factors.

III. PHYSICAL DATA

Boiling Point (EF): NA	Specific Gravity (H_2O=1): 2.45-2.55
Vapor Pressure (mm. Hg): NA	Melting Point: Approx. 1450EC
Vapor Density (Air = 1): NA	Evaporation Rate (Butyl Acetate = 1): NA
Solubility in Water: Insoluble, forms colloidal suspension.	pH: 8-10 (5% aqueous suspension)
Density (at 20E C): 55 lbs/cu.ft. as product.	

Appearance and Odor: Bluegray to green as moist solid, light tan to gray as dry powder. No odor.

IV. FIRE AND EXPLOSION DATA

Flash Point: NA	Flammable Limits: LEL: NA UEL: NA

Special Fire Fighting Procedures: NA

Unusual Fire and Explosion Hazards: None. Product will not support combustion.

Extinguishing Media: None for product. Any media can be used for the packaging. Product becomes slippery when wet.

V. REACTIVITY

Stability: Stable

Hazardous Polymerization: None

Incompatibility: None

Hazardous Decomposition Products: None

NA = Not Applicable ND = Not Determined

Date Prepared: March 11, 1999

Doc #: 10100-01

VI. HEALTH HAZARD INFORMATION

Routes of Exposure and Effects:

Skin: Possible drying resulting in dermatitis.

Eyes: Mechanical irritant.

Inhalation: Acute (short term) exposure to dust levels exceeding the PEL may cause irritation of respiratory tract resulting in a dry cough.

Chronic (long term) exposure to airborne bentonite dust containing respirable size (# 10 Φ) quartz particles, where respirable quartz particle levels are higher than TLV's, may lead to development of silicosis or other respiratory problems. Persistent dry cough and labored breathing upon exertion maybe symptomatic.

Ingestion: No adverse effects.

Permissible Exposure Limits: (for air contaminants)	OSHA PEL (8hr. TWA)	ACGIH TLV
Bentonite as "Particulates not otherwise regulated" (formerly nuisance dust)		
Total dust	15mg/m^3	ND
Respirable dust	5mg/m^3	ND
Crystalline Quartz (respirable)	0.1mg/m^3	0.1mg/m^3

Carcinogenicity: Bentonite is not listed by NTP or OSHA. IARC, 1997, concludes that there is sufficient evidence in humans for the carcinogenicity of inhaled crystalline silica from occupational sources (IARC Class 1), that carcinogenicity was not detected in all industrial circumstances studied and that carcinogenicity may depend on characteristics of the crystalline silica or on external factors affecting its biological activity.

Acute Oral LD_{50}: ND	Acute Dermal LD_{50}: ND	Aquatic Toxicology LC_{50}: ND

Emergency and First Aid Procedures:

Skin: Wash with soap and water until clean.

Eyes: Flush with water until irritation ceases.

Inhalation: Move to area free from dust. If symptoms of irritation persist contact physician. Inhalation may aggravate existing respiratory illness.

VII. HANDLING AND USE PRECAUTIONS

Steps to be Taken if Material is Released or Spilled: Avoid breathing dust; wear respirator approved for silica bearing dust. Vacuum up to avoid generating airborne dust. Avoid using water. Product slippery when wetted.

Waste Disposal Methods: Product should be disposed of in accordance with applicable local, state and federal regulations.

Handling and Storage Precautions: Use NIOSH/MSHA respirators approved for silica bearing dust when free silica containing airborne bentonite dust levels exceed PEL/TLV's. Clean up spills promptly to avoid making dust. Storage area floors may become slippery if wetted.

VIII. INDUSTRIAL HYGIENE CONTROL MEASURES

Ventilation Requirements: Mechanical, general room ventilation. Use local ventilation to maintain PEL's/TLV's.

Respirator: Use respirators approved by NIOSH/MSHA for silica bearing dust.

Eye Protection: Generally not necessary. Personal preference.

Gloves: Generally not necessary. Personal preference.

Other Protective Clothing or Equipment: None

IX. SPECIAL PRECAUTIONS

Avoid prolonged inhalation of airborne dust.

DEPARTMENT OF TRANSPORTATION HAZARDOUS MATERIAL INFORMATION

Shipping Name: NA (Not Regulated)	Hazard Class: NA
Hazardous Substance: NA	Cautionary Labeling: NA

Date Prepared: March 11, 1999 Doc #: 10100-01

All information presented herein is believed to be accurate, however, it is the user's responsibility to determine in advance of need that the information is current and suitable for their circumstances. No warranty or guarantee, expressed or implied is made by WYO-BEN, INC. as to this information, or as to the safety, toxicity or effect of the use of this product.

APPENDIX F

Record of Soil-Bentonite Mix Sample
(Hanson Engineering)

HANSON ENGINEERING P.C.
Soils, Foundations & Underground Specialists

RECORD OF SOIL-BENTONITE MIX SAMPLE

Project Name ACS Separation Barrier Wall Project Number: 00192-011

Project Location: Griffith, Indiana

Date/ Time	Station	Sample Number	Depth Interval of Sample	Slump	Wet Density Volume/ Weight	Moisture Content	Dry Density	Permeability
1/23/01 1:30 PM	6+67	S-1	12'-15'	8 1/4"	130.8 pcf	25.0%	104.6	3.3 x 10^-8 cm/s
1/24/01 8:30 AM	6+67	S-1A	0'-2'	6 1/2"	124.76 pcf	28.7%	96.9	
1/25/01 10:30 PM	5+95	S-2	12'-15'	5 1/2"	126.8 pcf	24.9%	101.5	
1/31/01 10:00 PM	4+85	S-3	10'-13'	8 3/4"	119.8 pcf	27.9%	95.4	3.4 x 10^-8 cm/s
1/31/01 2:45 PM	4+45	S-4	11'-14'	8 3/4"	121.0 pcf	22.0%	93.7	
1/31/01 3:30 PM	3+70	S-5	10'-13'	8 1/2"	122.2 pcf	31.0%	93.3	4.0 x 10^-8 cm/s
2/02/01 10:30 AM	2+95	S-6	12'-15'	8 "	122.0 pcf	29.4%	94.3	
2/02/01 11:15 AM	1+80	S-7	11'-14'	6 3/4"	120.0 pcf	35.0%	88.9	3.4 x 10^-8 cm/s
2/02/01 12:00 PM	1+05	S-8	12'-15'	8"	120.8 pcf	27.9%	94.4	
2/02/01 1:00 PM	0+30	S-9	12'-15'	9"	125.6 pcf	26.1%	99.6	3.7 x 10^-8 cm/s

Slump and unit weight samples taken at 75' intervals. First sample at 15' from start. Permeability testing to be taken every other sample at 150' intervals.

Submit to laboratory for:

1.) WC Determination
2.) Calculation of Dry Density
3.) Permeability with tap water

APPENDIX G

Laboratory Analyses

Primary Analyses: Soil-Bentonite Backfill Laboratory Test Results
(NTH Consultants, Ltd.)

NTH Consultants, Ltd.
Infrastructure Engineering
and Environmental Services

38955 Hills Tech Drive
Farmington Hills, MI 48331-3432
248.553.6300
248.324.5179 Fax

Mr. Dan Hanson, P.E.
Hanson Engineering, P.C.
9366 Lilley Road
Plymouth, Michigan 48170

February 27, 2001
Proj. No. 13-001340-01

RE: Soil-Bentonite Backfill Laboratory Test Results
American Chemical Service NPL Site
Griffith, Indiana

Dear Mr. Hanson:

This letter presents our laboratory test results for the laboratory and field-mixed soil-bentonite backfills from the above-referenced site. We completed the laboratory testing based on our scope of work stated in our proposal dated November 21, 2000 (NTH Proposal No. P-20001664-F) and additional work summarized in a letter dated February 6, 2001.

Background Information

A slurry wall was constructed at the American Chemical Service NPL Site in Griffith, Indiana. The design of the soil-bentonite backfill mix, which was used in the slurry wall construction, was presented in a report by J&L Testing Company, Inc., entitled "Final Report, Backfill Mix Design and Compatibility and Geomembrane Seam Evaluation, American Chemical Service, Inc. NPL Site, Griffith, Indiana Project" dated January 31, 1997. Based on the report, the soil-bentonite mixture would contain 4% bentonite.

NTH Consultants, Ltd., retained by your firm, has completed laboratory testing on soil-bentonite samples prepared both in the laboratory and the construction site. The laboratory testing included hydraulic conductivity tests and slump tests, as well as determination of moisture content.

Testing on Laboratory Prepared Soil-Bentonite Backfill Mixture

We have completed the permeability tests on two companion samples of laboratory-prepared soil-bentonite mixture. We prepared the soil-bentonite mixture using soil and bentonite samples sent to us by your firm. Two specimens of soil-bentonite backfill were prepared by adding the equivalent of 4 lbs. of oven-dry bentonite to 100 lbs. of dry soil. The moisture content of air-dry bentonite varies, depending on source and method of storage, but might typically be 10% to 12%. An equivalent mixture using air-dry bentonite might therefore be approximately 4.4 lbs. of air-dry bentonite to 100 lbs. of dry soil. Each specimen was then mixed to a moisture content of approximately 30%, creating a consistency equivalent to a high slump concrete, and was placed in the testing apparatus.

Hydraulic conductivity testing was performed in a fixed wall permeameter using the procedures of EPA Method 9100, Section 2.6. A confining load of 10 psi was placed on each specimen to match the average effective stress applied during the referenced mix design. The specimens were then

permeated with clean, deaired tap water until stable, repeatable permeability results were obtained. The hydraulic conductivities determined from the tests with the tap water on the two specimens were 5.8 x 10^{-8} and 7.1 x 10^{-8} cm/s.

After the stable results from the tap water hydraulic conductivity testing were obtained, we replaced the deaired tap water with site groundwater supplied to us by your firm as permeant. The hydraulic conductivity testing was terminated when approximately four pore volumes of the site groundwater had permeated through each specimen. The results of the groundwater hydraulic conductivity testing are presented in Figure 1, Permeant Exposure; Soil-Bentonite Backfill Mixture. As shown in the figure, the hydraulic conductivities determined from the tests with the site groundwater on the two specimens were 7.2 x 10^{-8} and 9.9 x 10^{-8} cm/s.

In addition, we also completed four slump tests on specimens of soil-bentonite mixtures prepared in our laboratory using the additional soil and bentonite you subsequently sent to us. We note that the moisture content and characteristics of these bentonite and soil materials may have differed somewhat from those used in the initial hydraulic conductivity testing. The specimens were prepared as the same manner as those were for the initial hydraulic conductivity testing. The results of the slump tests are summarized in Table 1 Summary of the Slump Tests.

TABLE 1
SUMMARY OF THE SLUMP TESTS

Moisture Content (%)	27	29	31	33.5
Slump (in.)	0.4	3.5	8.5	10

Testing on Field Prepared Soil-Bentonite Backfill Mixture

We have also completed the laboratory tests on ten field-mixed soil-bentonite samples sent to us from the construction site. These tests were conducted to determine the hydraulic conductivity and moisture content of the samples. The testing procedures for these field samples were similar to those used for the laboratory-prepared soil-bentonite samples, except that only deaired tap water was used as permeant. The results of these tests are summarized on Table 2, Summary of Laboratory Testing on Field-Mixed Soil-Bentonite Samples. As shown on Table 2, the hydraulic conductivities and moisture contents of the field samples range from 3.3 x 10^{-8} cm/s to 4.0 x 10^{-8} cm/s and 22.0% to 35.0%, respectively.

TABLE 2
SUMMARY OF LABORATORY TESTING ON FIELD-MIXED SOIL-BENTONITE SAMPLES

Wall Location	Sample Number	Moisture Content (%)	Hydraulic Conductivity (cm/s)
0+30	S-9	26.1	3.7 E-08
1+05	S-8	27.9	--
1+80	S-7	35.0	3.4 E-08
2+55	S-6	29.4	--
3+70	S-5	31.0	4.0 E-08
4+45	S-4	22.0	--
4+85	S-3	27.9	3.4 E-08
5+95	S-2	24.9	--
6+67	S-1	25.0	3.3 E-08
6+67	S-1A	28.7	--

If you have any questions regarding the information included with this report, please do not hesitate to contact us.

Sincerely,

NTH Consultants, Ltd.

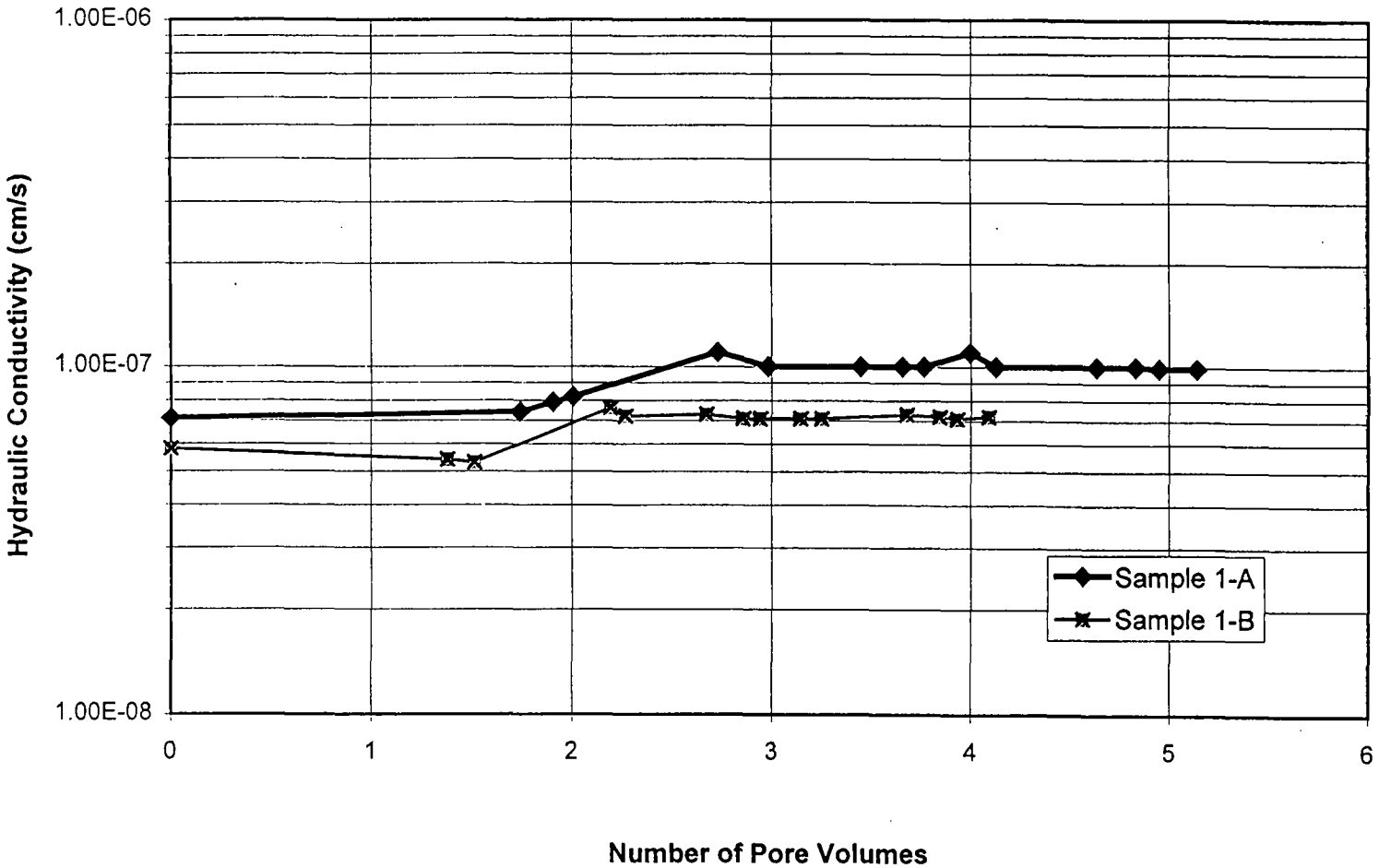
JengHwa Lyng, Ph.D., P.E.
Senior Project Engineer

Wayne R. Bergstrom / PB
Wayne R. Bergstrom, Ph.D., P.E.
Senior Project Consultant

JHL/WRB/pab

Attachment: Figure 1

Figure 1
Permeant Exposure; Soil-Bentonite Backfill Mixture
Hanson Engineering, P.C.
American Chemical Services NPL Site



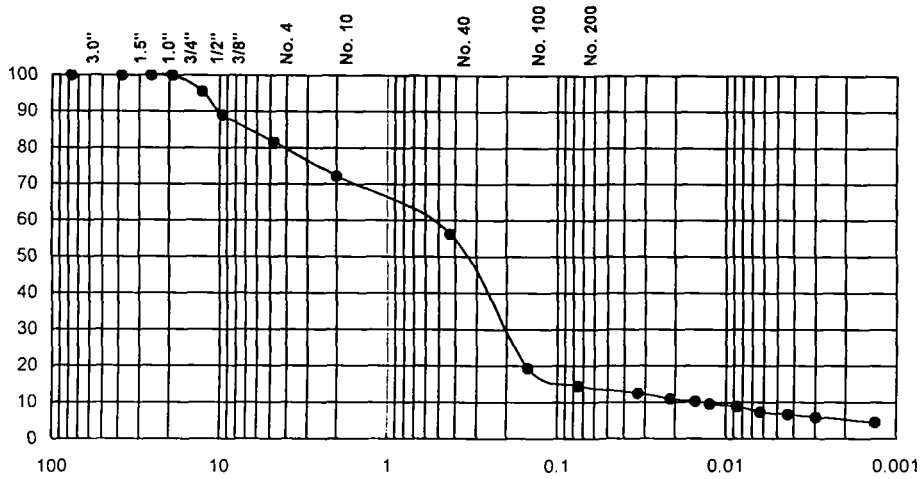
Confirmatory Analyses: Grain Size Analyses
(Great Lakes Soil & Environmental Consultants)

Great Lakes Soil & Environmental Consultants, Inc.
333 Shore Drive, Burr Ridge, IL 60521 Ph: (630) 321-0944 Fax: (630) 321-0945

GRAIN SIZE ANALYSIS (ASTM D422)

Project	ACS Separation Barrier Wall							
Client	Motgomery Watson, 27755 Diehl Road, Suite 300, Warrenville, IL 60555							
File No.	2049	Sample No.	#1 & 2 (1-23)	Date	2/8/01	Tested by	AK	Checked by	SB
		Location	0+18					

GRAIN SIZE ANALYSIS



% + 3"	% Gravel	% Sand	% Silt	% Clay
0.0	18.4	67.1	7.4	7.0

Sieve Size	Percent Passing
3.0"	100.0
1.5"	100.0
1.0"	100.0
3/4"	100.0
1/2"	95.5
3/8"	89.0
No. 4	81.6
No. 10	72.2
No. 40	56.2
No. 100	19.3
No. 200	14.5

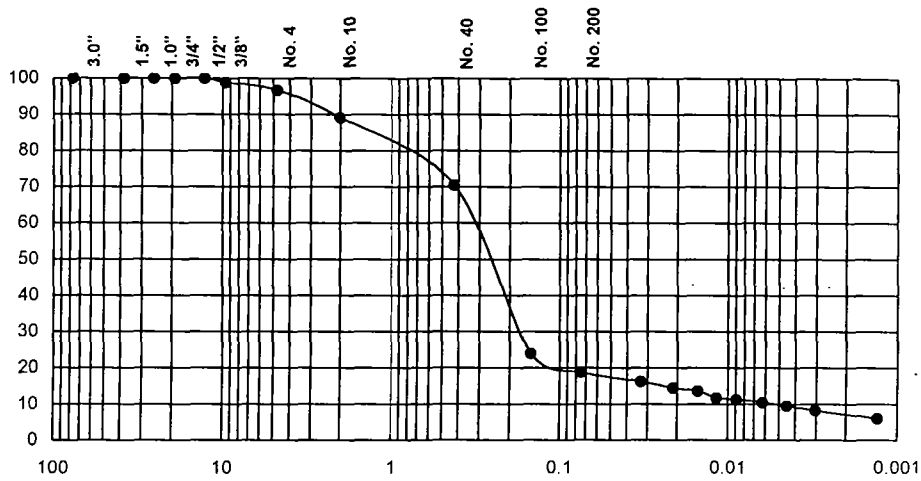
Liquid Limit, L_L	Plasticity Index, PI
N/A	N/A

Visual Soil Description:	Brown Clayey Sand with gravel
Soil Classification:	SC
System:	USCS

Great Lakes Soil & Environmental Consultants, Inc. 333 Shore Drive, Burr Ridge, IL 60521 Ph: (630) 321-0944 Fax: (630) 321-0945	GRAIN SIZE ANALYSIS (ASTM D422)

Project	ACS Separation Barrier Wall								
Client	Motgomery Watson, 27755 Diehl Road, Suite 300, Warrenville, IL 60555								
File No.	2049	Sample No.	#1 & 2 (1-25)	Date	2/8/01	Tested by	AK	Checked by	SB
		Location	Stn. 0+90						

GRAIN SIZE ANALYSIS



% + 3"	% Gravel	% Sand	% Silt	% Clay
0.0	3.2	77.9	8.9	9.9

Sieve Size	Percent Passing
3.0"	100.0
1.5"	100.0
1.0"	100.0
3/4"	100.0
1/2"	100.0
3/8"	98.9
No. 4	96.8
No. 10	89.2
No. 40	70.4
No. 100	24.0
No. 200	18.8

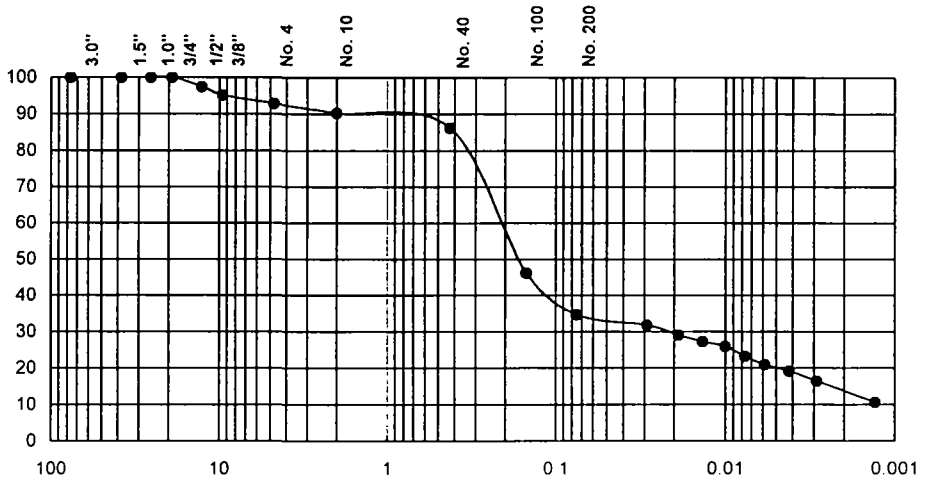
Liquid Limit, L_L	Plasticity Index, PI
N/A	N/A

Visual Soil Description:	Brown Clayey Sand
Soil Classification:	SC
System:	USCS

Great Lakes Soil & Environmental Consultants, Inc. 333 Shore Drive, Burr Ridge, IL 60521 Ph: (630) 321-0944 Fax: (630) 321-0945	GRAIN SIZE ANALYSIS (ASTM D422)

Project	ACS Separation Barrier Wall								
Client	Motgomery Watson, 27755 Diehl Road, Suite 300, Warrenville, IL 60555								
File No.	2049	Sample No.	#1 (Sta. 2+00)	Date	2/16/01	Tested by	AK	Checked by	SB
		Location	2+00						

GRAIN SIZE ANALYSIS



% + 3"	% Gravel	% Sand	% Silt	% Clay
0.0	7.2	58.1	14.7	20.1

Sieve Size	Percent Passing
3.0"	100.0
1.5"	100.0
1.0"	100.0
3/4"	100.0
1/2"	97.4
3/8"	95.2
No. 4	92.8
No. 10	90.3
No. 40	86.2
No. 100	46.2
No. 200	34.7

Liquid Limit, L_L	Plasticity Index, PI
N/A	N/A

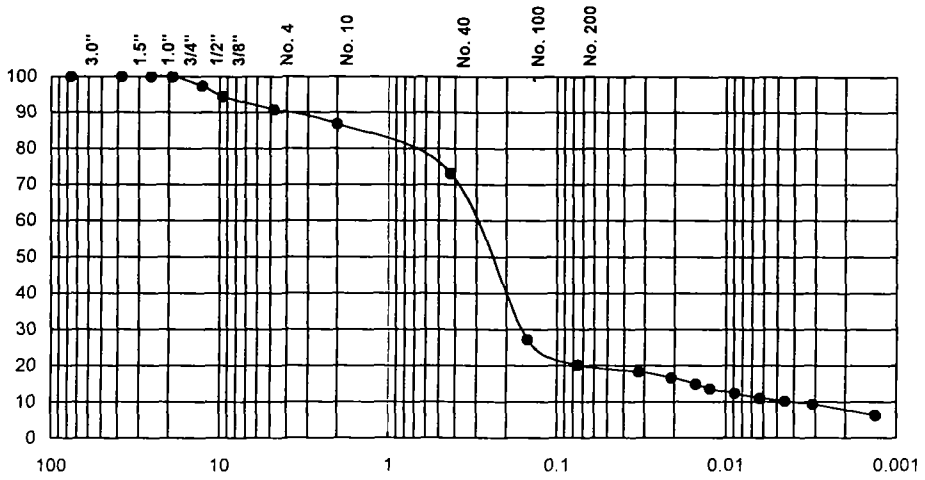
Visual Soil Description:	Brown Clayey Sand
Soil Classification:	SC
System:	USCS

Great Lakes Soil & Environmental Consultants, Inc.
333 Shore Drive, Burr Ridge, IL 60521 Ph: (630) 321-0944 Fax: (630) 321-0945

GRAIN SIZE ANALYSIS (ASTM D422)

Project	ACS Separation Barrier Wall								
Client	Motgomery Watson, 27755 Diehl Road, Suite 300, Warrenville, IL 60555								
File No.	2049	Sample No.	#1 (Sta. 2+40)	Date	2/16/01	Tested by	AK	Checked by	SB
		Location	2+40						

GRAIN SIZE ANALYSIS



% + 3"	% Gravel	% Sand	% Silt	% Clay
0.0	9.2	70.6	9.8	10.5

Sieve Size	Percent Passing
3.0"	100.0
1.5"	100.0
1.0"	100.0
3/4"	100.0
1/2"	97.3
3/8"	94.4
No. 4	90.8
No. 10	86.8
No. 40	73.1
No. 100	27.3
No. 200	20.2

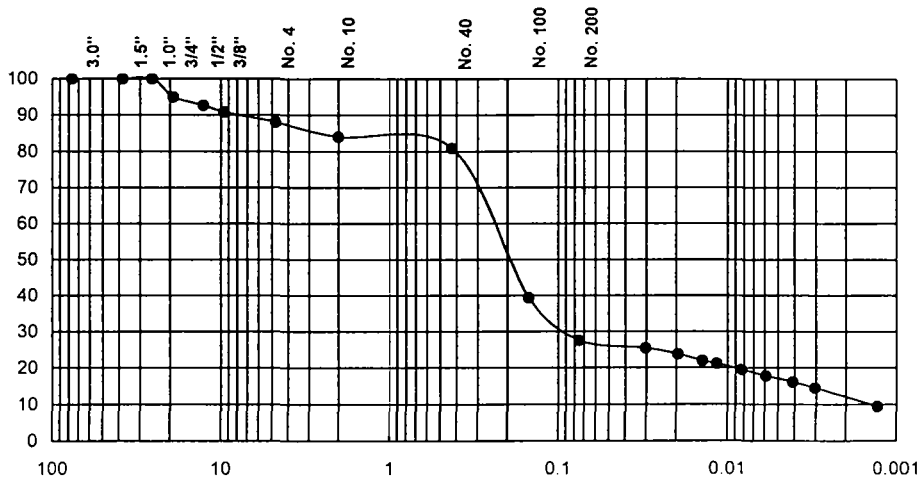
Liquid Limit, L_L	Plasticity Index, PI
N/A	N/A

Visual Soil Description:	Brown Clayey Sand
Soil Classification:	SC
System:	USCS

	Great Lakes Soil & Environmental Consultants, Inc. 333 Shore Drive, Burr Ridge, IL 60521 Ph: (630) 321-0944 Fax (630) 321-0945	**GRAIN SIZE ANALYSIS** **(ASTM D422)**

Project	ACS Separation Barrier Wall							
Client	Motgomery Watson, 27755 Diehl Road, Suite 300, Warrenville, IL 60555							
File No.	2049	Sample No.	#2 (Sta. 3+15)	Date	2/16/01	Tested by	AK	Checked by	SB
		Location	3+15					

GRAIN SIZE ANALYSIS



% + 3"	% Gravel	% Sand	% Silt	% Clay
0.0	11.9	60.6	10.5	17.0

Sieve Size	Percent Passing
3.0"	100.0
1.5"	100.0
1.0"	100.0
3/4"	95.0
1/2"	92.7
3/8"	90.8
No 4	88.1
No. 10	84.0
No. 40	80.8
No. 100	39.4
No. 200	27.5

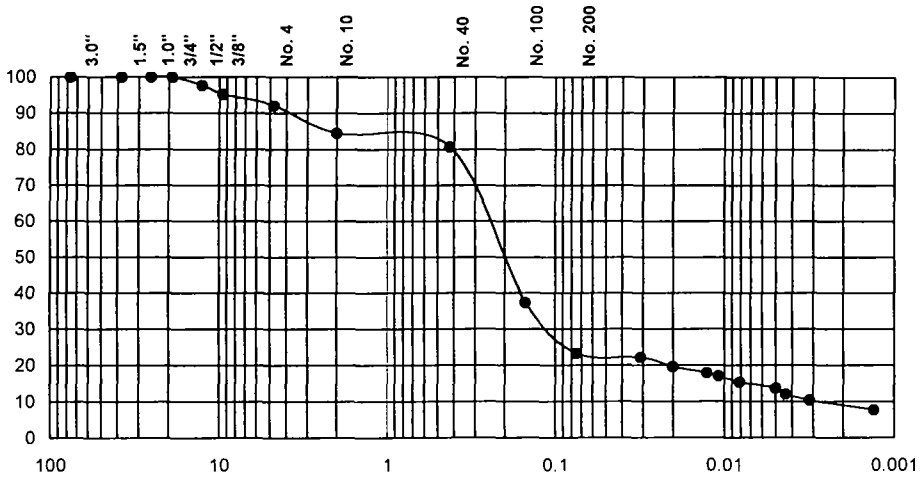
Liquid Limit, L_L	Plasticity Index, PI
N/A	N/A

Visual Soil Description:	Brown Clayey Sand
Soil Classification:	SC
System:	USCS

Great Lakes Soil & Environmental Consultants, Inc. 333 Shore Drive, Burr Ridge, IL 60521 Ph: (630) 321-0944 Fax: (630) 321-0945	GRAIN SIZE ANALYSIS (ASTM D422)

Project	ACS Separation Barrier Wall								
Client	Motgomery Watson, 27755 Diehl Road, Suite 300, Warrenville, IL 60555								
File No.	2049	Sample No.	#6B (Sta. 4+30)	Date	2/23/01	Tested by	AK	Checked by	SB
		Location	Sta. 4+30						

GRAIN SIZE ANALYSIS



% + 3"	% Gravel	% Sand	% Silt	% Clay
0.0	7.9	68.8	10.2	13.1

Sieve Size	Percent Passing
3.0"	100.0
1.5"	100.0
1.0"	100.0
3/4"	100.0
1/2"	97.7
3/8"	95.3
No. 4	92.1
No. 10	84.4
No. 40	80.6
No. 100	37.3
No. 200	23.3

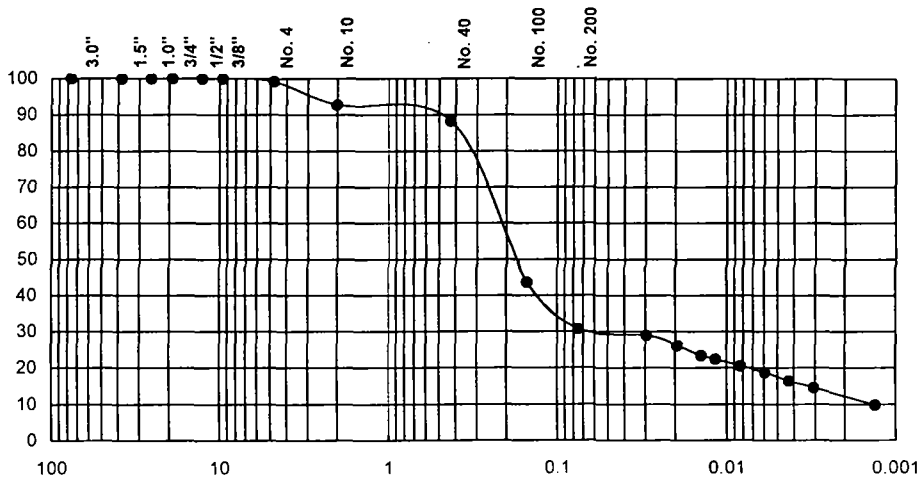
Liquid Limit, L_L	Plasticity Index, PI
N/A	N/A

Visual Soil Description:	Brown Clayey Sand
Soil Classification:	SC
System:	USCS

Great Lakes Soil & Environmental Consultants, Inc. 333 Shore Drive, Burr Ridge, IL 60521 Ph: (630) 321-0944 Fax: (630) 321-0945	GRAIN SIZE ANALYSIS (ASTM D422)

Project	ACS Separation Barrier Wall							
Client	Motgomery Watson, 27755 Diehl Road, Suite 300, Warrenville, IL 60555							
File No.	2049	Sample No.	#7B (Sta. 5+05)	Date	2/23/01	Tested by	AK	Checked by	SB
		Location	Sta. 5+05					

GRAIN SIZE ANALYSIS



% + 3"	% Gravel	% Sand	% Silt	% Clay
0.0	0.9	68.4	13.2	17.5

Sieve Size	Percent Passing
3.0"	100.0
1.5"	100.0
1.0"	100.0
3/4"	100.0
1/2"	100.0
3/8"	100.0
No. 4	99.1
No. 10	92.8
No. 40	88.3
No. 100	43.6
No. 200	30.7

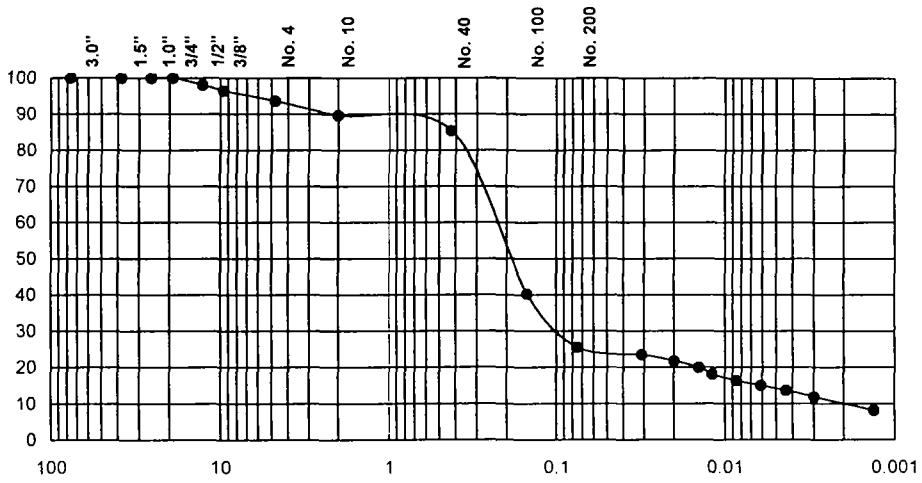
Liquid Limit, L_L	Plasticity Index, PI
N/A	N/A

Visual Soil Description:	Brown Clayey Sand
Soil Classification:	SC
System:	USCS

Great Lakes Soil & Environmental Consultants, Inc. 333 Shore Drive, Burr Ridge, IL 60521 Ph: (630) 321-0944 Fax: (630) 321-0945	GRAIN SIZE ANALYSIS (ASTM D422)

Project	ACS Separation Barrier Wall							
Client	Motgomery Watson, 27755 Diehl Road, Suite 300, Warrenville, IL 60555							
File No.	2049	Sample No.	#8A (Sta. 5+80)	Date	2/23/01,	Tested by	AK	Checked by	SB
		Location	Sta. 5+80					

GRAIN SIZE ANALYSIS



% + 3"	% Gravel	% Sand	% Silt	% Clay
0.0	6.3	68.2	11.3	14.2

Sieve Size	Percent Passing
3.0"	100.0
1.5"	100.0
1.0"	100.0
3/4"	100.0
1/2"	98.1
3/8"	96.4
No. 4	93.7
No. 10	89.7
No. 40	85.4
No. 100	40.3
No. 200	25.5

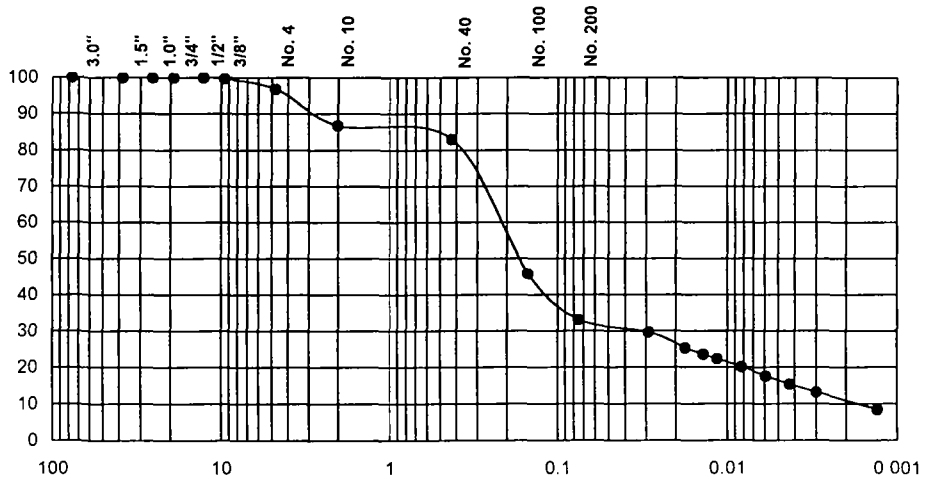
Liquid Limit, L_L	Plasticity Index, PI
N/A	N/A

Visual Soil Description:	Brown Clayey Sand
Soil Classification:	SC
System:	USCS

Great Lakes Soil & Environmental Consultants, Inc. 333 Shore Drive, Burr Ridge, IL 60521 Ph: (630) 321-0944 Fax: (630) 321-0945	GRAIN SIZE ANALYSIS (ASTM D422)

Project	ACS Separation Barrier Wall							
Client	Motgomery Watson, 27755 Diehl Road, Suite 300, Warrenville, IL 60555							
File No.	2049	Sample No.	#9A (Sta. 6+55)	Date	2/23/01	Tested by	AK	Checked by	SB
		Location	Sta. 6+55					

GRAIN SIZE ANALYSIS



% + 3"	% Gravel	% Sand	% Silt	% Clay
0.0	3.2	63.7	16.6	16.5

Sieve Size	Percent Passing
3.0"	100.0
1.5"	100.0
1.0"	100.0
3/4"	100.0
1/2"	100.0
3/8"	99.6
No. 4	96.8
No. 10	86.8
No. 40	83.0
No. 100	45.8
No. 200	33.1

Liquid Limit, L_L	Plasticity Index, PI
N/A	N/A

Visual Soil Description:	Brown Clayey Sand
Soil Classification:	SC
System:	USCS

Confirmatory Analyses: Permeability Analyses
(Great Lakes Soil & Environmental Consultants)

Great Lakes Soil & Environmental Consultants, Inc
333 Shore Drive, Burr Ridge, IL 60521 Ph: (630) 321-0944 Fax: (630) 321-0945

COEFFICIENT OF PERMEABILITY - ASTM D5084 (FLEXIBLE WALL)

Project	ACS Separation Barrier Wall						
Client	Motgomery Watson, 27755 Diehl Road, Suite 300, Warrenville, IL 60555						
File #	2049	**Date Tested**	2/8/01	**Tested by:**	AK	**QC by:**	SB
Sample ID:	#1A; 01/23		**Location**	0+18 Stn.			
Sample Description	*Soil Bentonite slurry mix*						

Specimen Data

Initial

Diameter:	7.42	cm	Area, A:	43.2	sq cm
Height, L:	3.59	cm	Volume, V:	155.3	cu cm
Mass of Sample:	266.6	g	**Moisture Content:**	**20.5**	**%**
			Wet Density	**107.1**	**pcf**
			Dry Density	**88.8**	**pcf**

Final

Diameter:	7.00	cm	Area, A:	38.5	sq cm
Height, L:	3.30	cm	Volume, V:	127.0	cu cm
Mass of Sample:	287.10	g	**Moisture Content:**	**12.3**	**%**
			Wet Density	**141.1**	**pcf**
			Dry Density	**125.6**	**pcf**
			Deg of Saturation	**92.3**	

Test Data

Permeant:	Deaired Tap Water	
Cell Pressure	50.0	psi
Top Pressure	46.5	psi
Bottom Pressure	47.0	psi
Gradient:	9.8	

Date	Time	Elapsed Time (Sec)	Cumulative Time (Sec)	Burette Readings		Outflow/Inflow Ratio	Fluid Temp. oC	Permeability cm/sec
				Outflow cc	Inflow cc			
2/8/01	11:15 AM	0	0	3.16	4.72		20	---
	12:15 PM	3600	3600	3.34	4.56	1.1	20	8.22E-08
	1:15 PM	3600	7200	3.53	4.40	1.2	20	8.69E-08
	2:15 PM	3600	10800	3.62	4.30	0.9	20	5.68E-08
	3:35 PM	4800	15600	3.72	4.20	1.0	20	4.41E-08
	4:45 PM	4200	19800	3.80	4.10	0.8	20	5.22E-08

Average Permeability = **6.4E-08** cm/sec

Remarks:

Quality, Service & Commitment

Great Lakes Soil & Environmental Consultants, Inc
333 Shore Drive, Burr Ridge, IL 60521 Ph: (630) 321-0944 Fax: (630) 321-0945

COEFFICIENT OF PERMEABILITY - ASTM D5084 (FLEXIBLE WALL)

Project	ACS Separation Barrier Wall						
Client	Motgomery Watson, 27755 Diehl Road, Suite 300, Warrenville, IL 60555						
File #	2049	**Date Tested**	2/8/01	**Tested by:**	AK	**QC by:**	SB
Sample ID:	#1B, 01/23		**Location**	0+18 Stn.			
Sample Description	Soil Bentonite slurry mix						

Specimen Data

Initial

Diameter:	7.46	cm	Area, A:	43.7	sq cm
Height, L:	3.98	cm	Volume, V:	174.1	cu cm
Mass of Sample:	322.5	g	**Moisture Content:**	**19.0**	**%**
			Wet Density	**115.6**	**pcf**
			Dry Density	**97.2**	**pcf**

Final

Diameter:	7.20	cm	Area, A:	40.7	sq cm
Height, L:	3.80	cm	Volume, V:	154.7	cu cm
Mass of Sample:	341.40	g	**Moisture Content:**	**10.0**	**%**
			Wet Density	**137.7**	**pcf**
			Dry Density	**125.1**	**pcf**
			Deg of Saturation	**74.3**	

Test Data

Permeant:	Deaired Tap Water
Cell Pressure	50.0 psi
Top Pressure	46.5 psi
Bottom Pressure	47.0 psi
Gradient:	8.8

Date	*Time*	Elapsed Time (Sec)	Cumulative Time (Sec)	Burette Readings		Outflow/Inflow Ratio	Fluid Temp. oC	Permeability cm/sec
				Outflow cc	*Inflow* cc			
2/8/01	10:15 AM	0	0	2.50	5.96		20	---
	11:15 AM	3600	3600	2.81	5.65	1.0	20	1.37E-07
	12:15 PM	3600	7200	3.10	5.42	1.3	20	1.09E-07
	1:15 PM	3600	10800	3.36	5.20	1.2	20	1.12E-07

Average Permeability = **1.2E-07** cm/sec

Remarks:

Great Lakes Soil & Environmental Consultants, Inc
333 Shore Drive, Burr Ridge, IL 60521 Ph: (630) 321-0944 Fax: (630) 321-0945

COEFFICIENT OF PERMEABILITY - ASTM D5084 (FLEXIBLE WALL)

Project	ACS Separation Barrier Wall						
Client	Motgomery Watson, 27755 Diehl Road, Suite 300, Warrenville, IL 60555						
File #	2049	**Date Tested**	2/8/01	**Tested by:**	AK	**QC by:**	SB
Sample ID:	#1A, 01/25		**Location**	0+90 Stn.			
Sample Description	Soil Bentonite slurry mix						

Specimen Data

Initial

Diameter:	7.36	cm	Area, A:	42.5	sq cm
Height, L:	5.00	cm	Volume, V:	212.6	cu cm
Mass of Sample:	405.0	g	**Moisture Content:**	**22.7**	**%**
			Wet Density	**118.9**	**pcf**
			Dry Density	**96.8**	**pcf**

Final

Diameter:	7.10	cm	Area, A:	39.6	sq cm
Height, L:	4.60	cm	Volume, V:	182.1	cu cm
Mass of Sample:	426.50	g	**Moisture Content:**	**8.6**	**%**
			Wet Density	**146.1**	**pcf**
			Dry Density	**134.6**	**pcf**
			Deg of Saturation	**85.6**	

Test Data

Permeant:	Deaired Tap Water	
Cell Pressure	50.0	psi
Top Pressure	46.5	psi
Bottom Pressure	47.0	psi
Gradient:	7.0	

Date	Time	Elapsed Time (Sec)	Cumulative Time (Sec)	Burette Readings		Outflow/Inflow Ratio	Fluid Temp. oC	Permeability cm/sec
				Outflow cc	Inflow cc			
2/8/01	10:15 AM	0	0	2.20	5.60		20	---
	11:15 AM	3600	3600	2.30	5.48	0.8	20	6.73E-08
	12:15 PM	3600	7200	2.45	5.34	1.1	20	8.10E-08
	1:15 PM	3600	10800	2.61	5.20	1.1	20	8.40E-08
	2:15 PM	3600	14400	2.90	5.10	2.9	20	6.28E-08

Average Permeability = **7.4E-08** cm/sec

Remarks:

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COEFFICIENT OF PERMEABILITY - ASTM D5084 (FLEXIBLE WALL)

Project	ACS Separation Barrier Wall						
Client	Motgomery Watson, 27755 Diehl Road, Suite 300, Warrenville, IL 60555						
File #	2049	**Date Tested**	2/8/01	**Tested by:**	AK	**QC by:**	SB
Sample ID:	#1B, 01/25		**Location**	0+90 Stn.			
Sample Description	Soil Bentonite slurry mix						

Specimen Data

Initial

Diameter:	7.35	cm	Area, A:	42.4	sq cm
Height, L:	5.68	cm	Volume, V:	240.8	cu cm
Mass of Sample:	468.4	g	**Moisture Content:**	**18.3**	**%**
			Wet Density	**121.4**	**pcf**
			Dry Density	**102.6**	**pcf**

Final

Diameter:	7.05	cm	Area, A:	39.0	sq cm
Height, L:	5.40	cm	Volume, V:	210.8	cu cm
Mass of Sample:	488.20	g	**Moisture Content:**	**8.4**	**%**
			Wet Density	**144.5**	**pcf**
			Dry Density	**133.3**	**pcf**
			Deg of Saturation	**80.4**	

Test Data

Permeant:	Deaired Tap Water	
Cell Pressure	50.0	psi
Top Pressure	46.5	psi
Bottom Pressure	47.0	psi
Gradient:	6.2	

Date	Time	Elapsed Time (Sec)	Cumulative Time (Sec)	Burette Readings		Outflow/Inflow Ratio	Fluid Temp. oC	Permeability cm/sec
				Outflow cc	Inflow cc			
2/8/01	10:15 AM	0	0	3.04	5.28		20	---
	11:15 AM	3600	3600	3.15	5.16	0.9	20	8.91E-08
	12:15 PM	3600	7200	3.22	5.10	1.2	20	4.57E-08
	1:15 PM	3600	10800	3.33	4.96	0.8	20	1.10E-07
	2:15 PM	3600	14400	3.46	4.84	1.1	20	9.75E-08
						Average Permeability =		**8.5E-08** cm/sec

Remarks:	

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COEFFICIENT OF PERMEABILITY - ASTM D5084 (FLEXIBLE WALL)

Project	ACS Separation Barrier Wall					
Client	Motgomery Watson, 27755 Diehl Road, Suite 300, Warrenville, IL 60555					
File #	2049	**Date Tested**	2/19/01	**Tested by:**	AK	**QC by:** SB
Sample ID:	#1	**Location**	2+00 (12' - 15')			
Sample Description	Soil Bentonite slurry mix					

Specimen Data

Initial

Diameter:	7.30	cm	Area, A:	41.9	sq cm
Height, L:	6.50	cm	Volume, V:	272.0	cu cm
Mass of Sample:	433.0	g	**Moisture Content:**	**6.5**	**%**
			Wet Density	**99.3**	**pcf**
			Dry Density	**93.3**	**pcf**

Final

Diameter:	7.10	cm	Area, A:	39.6	sq cm
Height, L:	6.20	cm	Volume, V:	245.5	cu cm
Mass of Sample:	488.50	g	**Moisture Content:**	**19.9**	**%**
			Wet Density	**124.2**	**pcf**
			Dry Density	**103.6**	**pcf**
			Deg of Saturation	**83.4**	

Test Data

Permeant:	Deaired Tap Water	
Cell Pressure	50.0	psi
Top Pressure	45.0	psi
Bottom Pressure	46.0	psi
Gradient:	10.8	

Date	Time	Elapsed Time (Sec)	Cumulative Time (Sec)	Burette Readings		Outflow/Inflow Ratio	Fluid Temp. oC	Permeability cm/sec
				Outflow cc	Inflow cc			
2/19/01	10:35 AM	0	0	2.04	5.78		20	---
	11:45 AM	4200	4200	2.48	5.42	1.2	20	1.42E-07
	12:40 PM	3300	7500	2.80	5.12	1.1	20	1.59E-07
	3:00 PM	8400	15900	3.50	4.56	1.3	20	1.26E-07

Average Permeability = **1.4E-07** cm/sec

Remarks:

Quality, Service & Commitment

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COEFFICIENT OF PERMEABILITY - ASTM D5084 (FLEXIBLE WALL)

Project	ACS Separation Barrier Wall						
Client	Motgomery Watson, 27755 Diehl Road, Suite 300, Warrenville, IL 60555						
File #	2049	**Date Tested**	2/19/01	**Tested by:**	AK	**QC by:**	SB
Sample ID:	#1		**Location**	2+40 (1-31)			
Sample Description	Soil Bentonite slurry mix						

Specimen Data

Initial

Diameter:	7.20	cm	Area, A:	40.7	sq cm
Height, L:	5.90	cm	Volume, V:	240.2	cu cm
Mass of Sample:	423.8	g	**Moisture Content:**	**3.1**	**%**
			Wet Density	**110.1**	**pcf**
			Dry Density	**106.8**	**pcf**

Final

Diameter:	6.90	cm	Area, A:	37.4	sq cm
Height, L:	5.90	cm	Volume, V:	220.6	cu cm
Mass of Sample:	472.90	g	**Moisture Content:**	**18.5**	**%**
			Wet Density	**133.8**	**pcf**
			Dry Density	**112.9**	**pcf**
			Deg of Saturation	**97.8**	

Test Data

Permeant:	Deaired Tap Water	
Cell Pressure	50.0	psi
Top Pressure	45.0	psi
Bottom Pressure	46.0	psi
Gradient:	11.9	

Date	Time	Elapsed Time (Sec)	Cumulative Time (Sec)	Burette Readings		Outflow/Inflow Ratio	Fluid Temp. oC	Permeability cm/sec
				Outflow cc	Inflow cc			
2/19/01	10:35 AM	0	0	1.76	5.52		20	---
	11:45 AM	4200	4200	2.66	4.68	1.1	20	3.20E-07
	12:40 PM	3300	7500	3.28	4.06	1.0	20	3.40E-07
	3:00 PM	8400	15900	4.66	2.72	1.0	20	3.49E-07
	4:20 PM	4800	20700	5.16	2.24	1.0	20	2.72E-07
						Average Permeability =	**3.2E-07**	cm/sec

Remarks:	

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COEFFICIENT OF PERMEABILITY - ASTM D5084 (FLEXIBLE WALL)

Project	ACS Separation Barrier Wall					
Client	Motgomery Watson, 27755 Diehl Road, Suite 300, Warrenville, IL 60555					
File #	2049	**Date Tested**	2/19/01	**Tested by:**	AK	**QC by:** SB
Sample ID:	#2	**Location**	3+15			
Sample Description	Soil Bentonite slurry mix					

Specimen Data

Initial

Diameter:	7.00	cm	Area, A:	38.5	sq cm
Height, L:	6.30	cm	Volume, V:	242.5	cu cm
Mass of Sample:	488.7	g	**Moisture Content:**	**22.6**	%
			Wet Density	**125.8**	pcf
			Dry Density	**102.6**	pcf

Final

Diameter:	7.00	cm	Area, A:	38.5	sq cm
Height, L:	6.20	cm	Volume, V:	238.6	cu cm
Mass of Sample:	508.90	g	**Moisture Content:**	**21.5**	%
			Wet Density	**133.1**	pcf
			Dry Density	**109.6**	pcf
			Deg of Saturation	**104.2**	

Test Data

Permeant:	Deaired Tap Water
Cell Pressure	50.0 psi
Top Pressure	45.0 psi
Bottom Pressure	46.0 psi
Gradient:	11.2

Date	Time	Elapsed Time (Sec)	Cumulative Time (Sec)	Burette Readings		Outflow/Inflow Ratio	Fluid Temp. oC	Permeability cm/sec
				Outflow cc	Inflow cc			
2/19/01	10:35 AM	0	0	2.42	5.22		20	---
	11:45 AM	4200	4200	3.86	3.88	1.1	20	6.51E-07
	12:40 PM	3300	7500	4.74	3.00	1.0	20	6.78E-07
	3:00 PM	8400	15900	6.30	1.52	1.1	20	6.07E-07
	4:20 PM	4800	20700	6.68	1.04	0.8	20	4.83E-07
						Average Permeability =		**6.0E-07** cm/sec

Remarks:

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COEFFICIENT OF PERMEABILITY - ASTM D5084 (FLEXIBLE WALL)

Project	ACS Separation Barrier Wall						
Client	Motgomery Watson, 27755 Diehl Road, Suite 300, Warrenville, IL 60555						
File #	2049	**Date Tested**	2/21/01	**Tested by:**	AK	**QC by:**	SB
Sample ID:	#6B		**Location**	4+30			
Sample Description	Soil Bentonite slurry mix						

Specimen Data

Initial

Diameter:	7.00	cm	Area, A:	38.5	sq cm
Height, L:	6.60	cm	Volume, V:	254.0	cu cm
Mass of Sample:	539.9	g	**Moisture Content:**	**26.3**	**%**
			Wet Density	**132.6**	**pcf**
			Dry Density	**105.0**	**pcf**

Final

Diameter:	7.00	cm	Area, A:	38.5	sq cm
Height, L:	6.60	cm	Volume, V:	254.0	cu cm
Mass of Sample:	547.60	g	**Moisture Content:**	**22.6**	**%**
			Wet Density	**134.5**	**pcf**
			Dry Density	**109.7**	**pcf**
			Deg of Saturation	**110.3**	

Test Data

Permeant:	Deaired Tap Water
Cell Pressure	50.0 psi
Top Pressure	45.0 psi
Bottom Pressure	46.5 psi
Gradient:	16.0

Date	Time	Elapsed Time (Sec)	Cumulative Time (Sec)	Burette Readings		Outflow/Inflow Ratio	Fluid Temp. oC	Permeability cm/sec
				Outflow cc	Inflow cc			
2/22/01	10:06 AM	0	0	1.72	5.96		20	---
	11:29 AM	4980	4980	1.92	5.80	1.3	20	4.11E-08
	12:30 PM	3660	8640	2.06	5.68	1.2	20	4.27E-08
	1:50 PM	4800	13440	2.24	5.51	1.1	20	4.68E-08
	2:50 PM	3600	17040	2.40	5.38	1.2	20	4.86E-08
	4:07 PM	4620	21660	2.54	5.24	1.0	20	4.14E-08
	5:00 PM	3180	24840	2.66	5.11	0.9	20	5.67E-08
						Average Permeability =		**4.6E-08** cm/sec

Remarks:

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COEFFICIENT OF PERMEABILITY - ASTM D5084 (FLEXIBLE WALL)

Project	ACS Separation Barrier Wall						
Client	Motgomery Watson, 27755 Diehl Road, Suite 300, Warrenville, IL 60555						
File #	2049	**Date Tested**	2/21/01	**Tested by:**	AK	**QC by:**	SB
Sample ID:	#7B		**Location**	5+05			
Sample Description	Soil Bentonite slurry mix						

Specimen Data

Initial

Diameter:	7.20	cm	Area, A:	40.7	sq cm
Height, L:	6.70	cm	Volume, V:	272.8	cu cm
Mass of Sample:	527.3	g	**Moisture Content:**	**28.7**	%
			Wet Density	**120.6**	pcf
			Dry Density	**93.7**	pcf

Final

Diameter:	7.20	cm	Area, A:	40.7	sq cm
Height, L:	6.70	cm	Volume, V:	272.8	cu cm
Mass of Sample:	535.80	g	**Moisture Content:**	**23.1**	%
			Wet Density	**122.6**	pcf
			Dry Density	**99.6**	pcf
			Deg of Saturation	**87.8**	

Test Data

Permeant:	Deaired Tap Water	
Cell Pressure	50.0	psi
Top Pressure	45.0	psi
Bottom Pressure	46.5	psi
Gradient:	15.7	

Date	Time	Elapsed Time (Sec)	Cumulative Time (Sec)	Burette Readings		Outflow/Inflow Ratio	Fluid Temp. oC	Permeability cm/sec
				Outflow cc	Inflow cc			
2/22/01	10:07 AM	0	0	1.88	5.76		20	---
	11:29 AM	4920	4920	2.04	5.63	1.2	20	3.30E-08
	12:30 PM	3660	8580	2.18	5.54	1.6	20	3.12E-08
	1:50 PM	4800	13380	2.34	5.40	1.1	20	3.75E-08
	2:50 PM	3600	16980	2.46	5.30	1.2	20	3.62E-08
	4:07 PM	4620	21600	2.61	5.15	1.0	20	4.30E-08
	5:00 PM	3180	24780	2.71	5.04	0.9	20	4.64E-08
						Average Permeability =		**3.8E-08** cm/sec

Remarks:

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COEFFICIENT OF PERMEABILITY - ASTM D5084 (FLEXIBLE WALL)

Project	ACS Separation Barrier Wall					
Client	Motgomery Watson, 27755 Diehl Road, Suite 300, Warrenville, IL 60555					
File #	2049	Date Tested	2/21/01	Tested by:	AK	QC by: SB
Sample ID:	#8A	Location	5+80			
Sample Description	Soil Bentonite slurry mix					

Specimen Data

Initial

Diameter:	7.20	cm	Area, A:	40.7	sq cm
Height, L:	5.00	cm	Volume, V:	203.6	cu cm
Mass of Sample:	439.3	g	**Moisture Content:**	**21.3**	%
			Wet Density	**134.7**	pcf
			Dry Density	**111.0**	pcf

Final

Diameter:	7.10	cm	Area, A:	39.6	sq cm
Height, L:	5.20	cm	Volume, V:	205.9	cu cm
Mass of Sample:	433.50	g	**Moisture Content:**	**21.6**	%
			Wet Density	**131.4**	pcf
			Dry Density	**108.1**	pcf
			Deg of Saturation	**100.9**	

Test Data

Permeant:	Deaired Tap Water	
Cell Pressure	50.0	psi
Top Pressure	45.0	psi
Bottom Pressure	46.5	psi
Gradient:	21.1	

Date	Time	Elapsed Time (Sec)	Cumulative Time (Sec)	Burette Readings		Outflow/Inflow Ratio	Fluid Temp. oC	Permeability cm/sec
				Outflow cc	Inflow cc			
2/22/01	10:07 AM	0	0	1.78	5.86		20	---
	11:29 AM	4920	4920	2.10	5.55	1.0	20	5.87E-08
	12:30 PM	3660	8580	2.35	5.36	1.3	20	4.97E-08
	1:50 PM	4800	13380	2.64	5.08	1.0	20	5.75E-08
	2:50 PM	3600	16980	2.84	4.90	1.1	20	5.06E-08
	4:07 PM	4620	21600	3.10	4.64	1.0	20	5.85E-08
	5:00 PM	3180	24780	3.26	4.46	0.9	20	6.04E-08
						Average Permeability =		**5.6E-08** cm/sec

Remarks:

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COEFFICIENT OF PERMEABILITY - ASTM D5084 (FLEXIBLE WALL)

Project	ACS Separation Barrier Wall						
Client	Motgomery Watson, 27755 Diehl Road, Suite 300, Warrenville, IL 60555						
File #	2049	**Date Tested**	2/21/01	**Tested by:**	AK	**QC by:**	SB
Sample ID:	#9A		**Location**	6+55			
Sample Description	Soil Bentonite slurry mix						

Specimen Data

Initial

Diameter:	7.30	cm	Area, A:	41.9	sq cm
Height, L:	5.50	cm	Volume, V:	230.2	cu cm
Mass of Sample:	488.6	g	**Moisture Content:**	**21.4**	**%**
			Wet Density	**132.4**	**pcf**
			Dry Density	**109.1**	**pcf**

Final

Diameter:	7.20	cm	Area, A:	40.7	sq cm
Height, L:	5.80	cm	Volume, V:	236.1	cu cm
Mass of Sample:	500.20	g	**Moisture Content:**	**18.3**	**%**
			Wet Density	**132.2**	**pcf**
			Dry Density	**111.7**	**pcf**
			Deg of Saturation	**93.9**	

Test Data

Permeant:	Deaired Tap Water	
Cell Pressure	50.0	psi
Top Pressure	45.0	psi
Bottom Pressure	46.5	psi
Gradient:	19.2	

Date	Time	Elapsed Time (Sec)	Cumulative Time (Sec)	Burette Readings		Outflow/Inflow Ratio	Fluid Temp. oC	Permeability cm/sec
				Outflow cc	Inflow cc			
2/23/01	12:00 PM	0	0	2.22	5.70		20	---
	1:03 PM	3780	3780	3.02	4.92	1.0	20	2.18E-07
	2:26 PM	4980	8760	3.86	4.10	1.0	20	1.91E-07
	3:18 PM	3120	11880	4.32	3.68	1.1	20	1.70E-07
	4:10 PM	3120	15000	4.66	3.36	1.1	20	1.36E-07
						Average Permeability =		**1.8E-07** cm/sec

Remarks: